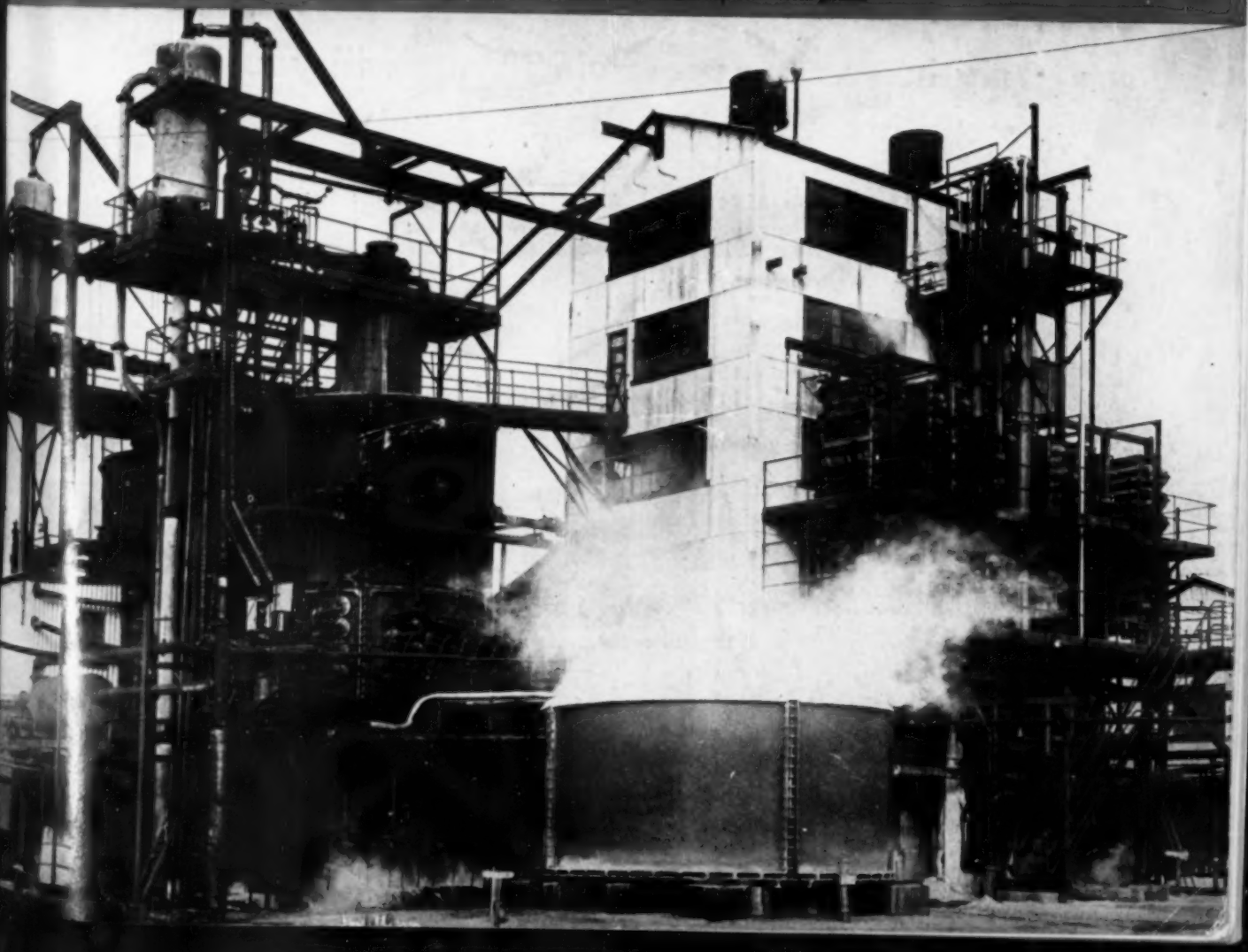
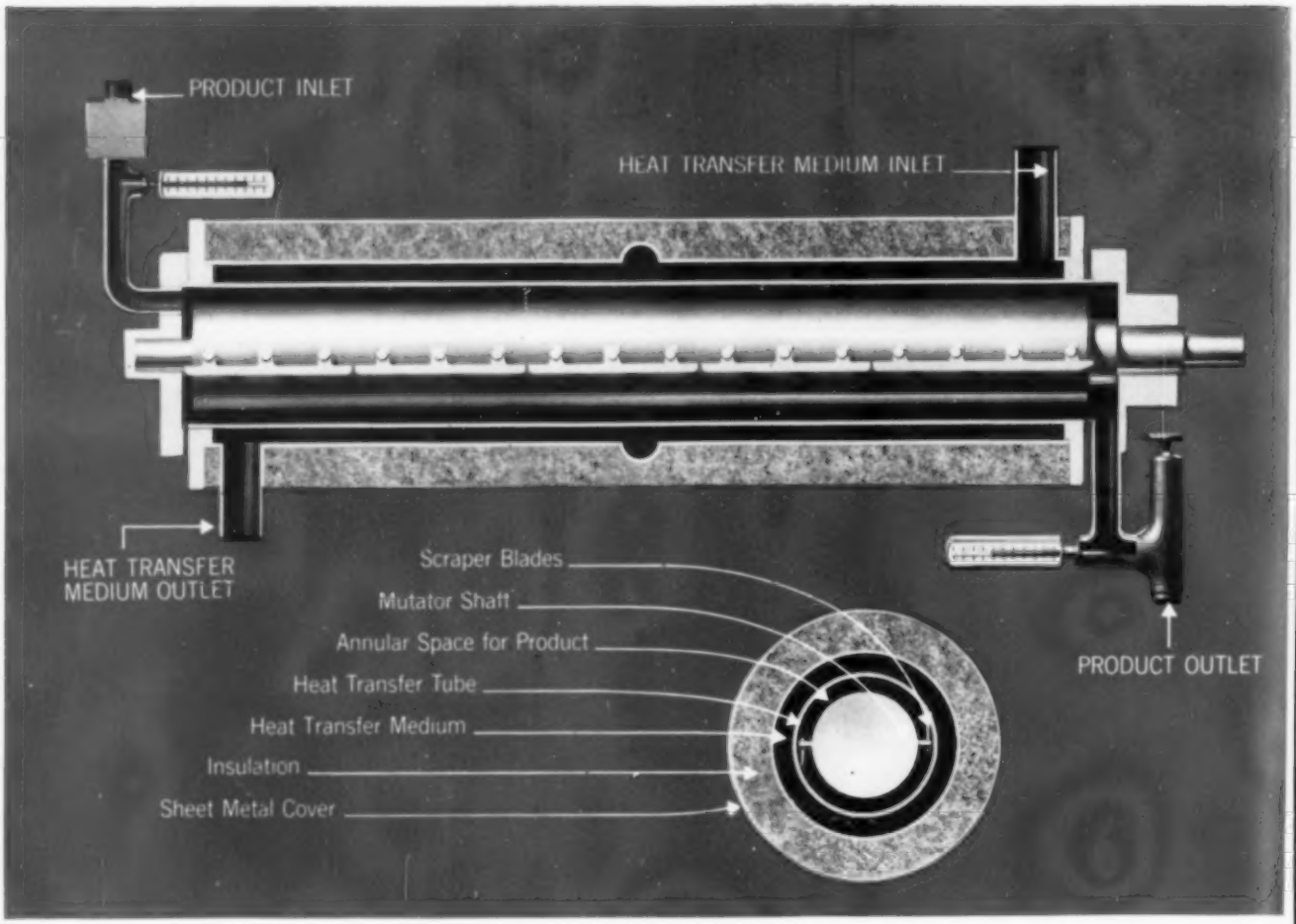
CHEMICAL ENGINEERING

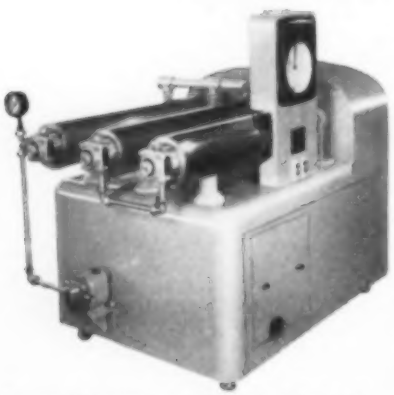
WITH CHEMICAL & METALLURGICAL ENGINEERING

Unit for concentrating sulphuric acid in a New Jersey chemical plant





Only in Votator processing units will you find this continuous, closed heat transfer mechanism



This model incorporates VOTATOR cylinders for both heating and cooling. Slurry for starch paste is heated from 76°F to 196°F in 10 seconds, cooled back to room temperature in 20 seconds as it thickens into paste. A total heat transfer cycle of 30 seconds that adds up to a 1800 pound hourly output from this compact machine.

VOTATOR equipment is setting new records for operating efficiency in the processing of viscous materials. This improved heat transfer mechanism is one of the exclusive reasons why. It is the most effective application of the basic theory that a high ratio of heat transfer surface to volume of material being treated does the best job.

The material is forced into a narrow annular passage, there contacts the heat transfer surface as a thin film. Revolving scraper blades constantly expose a clean heat transfer surface to the incoming material. The material is heated or cooled in seconds, on a continuous basis. A remarkable volume is handled in relation to size of the equipment. Compact, closed, the operation is accomplished with a highly economical use of heat transfer medium, and with precise mechanical control over quality.

Lard, photo emulsions, starch paste, margarine, shortening, printing ink, polishes, paraffin wax, lubricating grease—all are being more effectively processed with VOTATOR equipment. If your processing of liquids and viscous materials involves heat transfer write for data to The Girdler Corporation, Votator Division, Louisville 1, Kentucky.

• • •

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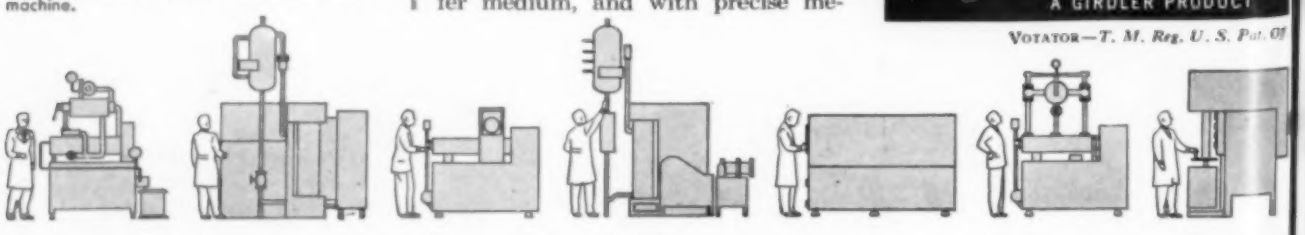
THE Votator
A GIRDLER PRODUCT

VOTATOR—*T. M. Reg. U. S. Pat. Off.*



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In this Issue

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LABOR DAY • 1946

—Time for wise union leadership

LABOR DAY, 1946, finds one hopeful element in the relations between American management and labor which was not there on Labor Day, 1945. It comes in recent expressions by a number of national leaders of organized labor that increased "real" wages depend upon *increased productivity*, i.e. increased output per man-hour. Increased money wages which are promptly offset by higher prices do nobody any good.

If these expressions, *which still remain to be substantiated by practical performance*, come to be accepted by the rank and file of labor in each community, Labor Day, 1946, can usher in a period of great and perhaps unprecedented improvement in the economic wellbeing of wage earners—as well as the wellbeing of the country at large. If, on the contrary, they remain merely window dressing and there is a continuation of the post V-J Day process of increasing wages and then prices, the outcome can only be the bursting of an inflationary bubble, with attendant suffering for workers and the community generally.

Competition requires management to bear down heavily on increased labor productivity as a prelude to wage increases. Management, however, has rarely made a more forthright statement on the importance of increasing labor productivity than that contained in a recent issue of LABOR'S MONTHLY SURVEY, an official publication of the American Federation of Labor.

William Green, the Federation president, led off with a "message to American workers." He remarked, "Our major need is increased volume of production." Observing that "wage increases this spring have been paid for by raising prices," the survey itself goes on to say that "Today America's ability to raise wages without increasing prices and living costs depends on increasing productivity in civilian industries . . . Here is the challenge to free labor and free enterprise today: *Cooperate to increase productivity and raise living standards without strikes.*" (Italics supplied.)

The importance of increasing production was also recently stressed by Walter Reuther, President of the United Automobile Workers, C.I.O., who remarked that his union "is just as eager as management to get the (automobile) industry into maximum production." In taking this general line he was in accord with the position of Philip Murray, head of the C.I.O., who in a book, "Organized Labor and Production" written with Morris L. Cooke, remarks that, "The modern labor leader also realizes that to receive a good day's pay a man must do a good day's work and that *increased productivity has been the vital factor in the country's industrial supremacy and its relatively high wage scale.*" (Italics supplied.)

In citing increased productivity as the key to increased "real" wages these labor leaders—and management—have the historical record entirely on

SPOT CHECK ON LABOR OUTPUT

In the absence of reliable general statistics on what has happened to productivity of labor since V-J Day (because of strikes and reconversion complications) the McGraw-Hill Publishing Company asked the executives of a cross section of American industry to report their own impressions. The questions asked and summaries of the replies, which varied markedly from industry to industry and plant to plant, follow.

Question No. 1. How well have workers performed since V-J Day as compared to their pre-war effort?

Answer. Worker effort has been below pre-war. There are exceptions, particularly among older and more experienced workers; and there are quite a few signs of improvement.

Question No. 2. How much headway have you been able to make since V-J Day in improving labor productivity by better equipment and organization?

Answer. Some headway is generally being made, but it has been greatly retarded by inability to get new equipment and, in some cases, by lack of labor cooperation in improvements in organization.

Question No. 3. How much improvement in equipment and organization is to be anticipated in your business over the next year?

Answer. Marked improvement in productivity (in a few cases as much as 20 per cent) can generally be made if there is sustained production and full cooperation between labor and management.

their side. In the 40 years prior to the outbreak of World War II output per man-hour for the country as a whole was approximately doubled. Over the same period the "real" hourly earnings of industrial workers were also approximately doubled. There were, of course, great variations in the increase of output per man-hour from one line of activity to another. Also, there were periods when increases in "real" wage rates lagged behind increases in productivity. But for the 40 year period as a whole and the economy as a whole there is no mistaking the fact that the route to increased "real" wage rates was increased productivity.

Three economic factors played major roles in this doubling of production per man-hour which has made America the industrial marvel of the modern world. One was the skill and diligence of American workers. A second was the skill and diligence of American management in organizing production. A third was the improvement of machinery and the increased application of power to it.

Wartime Record

During World War II this sustained increase in the productivity of labor in *civilian* manufacturing industries, which had averaged about 3 per cent a year, was brought to an abrupt halt. Much of the most efficient segment of the nation's labor force went to war or war industry. Also, civilian industry was starved for new equipment while we equipped our arsenals. The result was that the productivity of labor in those civilian manufacturing industries for which the government keeps records actually declined throughout most of the war. By 1945 it was no higher than in 1941, whereas, if it had maintained the long run average, it would have been about 12 per cent higher. In the meantime, however, average hourly wages in these civilian industries had increased about 40 per cent.

In *war* industry, which started from low levels of production at strange tasks, there were substantial increases in output per man-hour. Many of these increases involved new processes, improved techniques, and better machines which can be adapted over a period of time to the improvement of productivity of labor in civilian industry.

Since V-J Day, however, labor, led on by a misguided government, has had its sights on higher money wages instead of improving productivity which would have laid the foundation for increased "real" wages. Consequently, debilitating industrial strife ended in a round of wage increases which, in the absence of increased productivity, is being washed out by higher prices.

To Keep Production Rolling

However, as indicated by the summary of a McGraw-Hill sampling of the current experience of industry in increasing output per man-hour, which appears in the center of the page, there is hope that the situation ahead can be improved. After agonizing delays because of work stoppages, material shortages, and reconversion complications, industrial production is beginning to roll again. Allowed to roll it will not be long before it will be making those advances in productivity which are the only true basis for increased "real" wages.

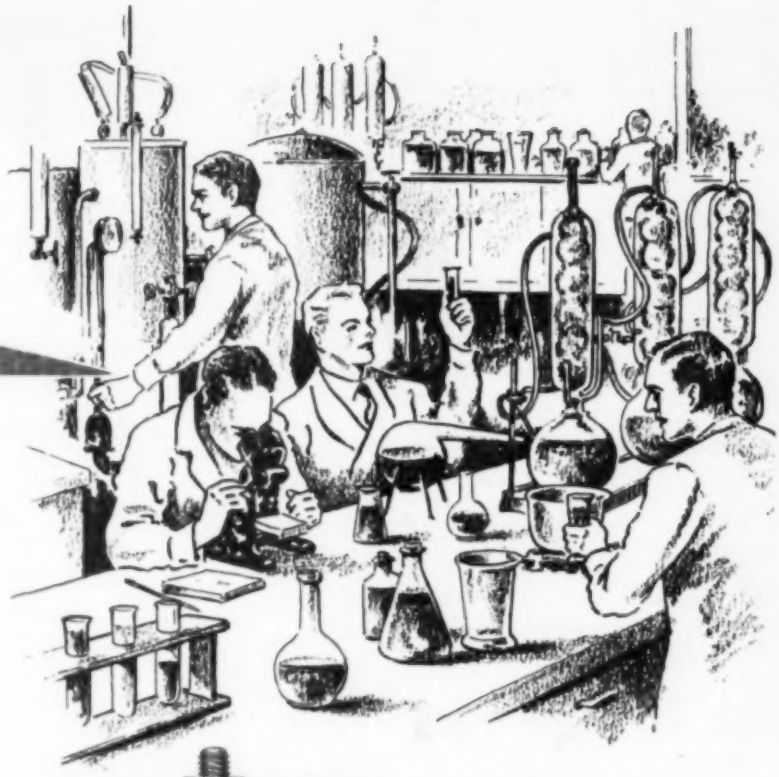
If the process of keeping American industry rolling to new highs of productivity is to be resumed, management must see that the past practice of translating increased output per man-hour into increased "real" wages is not only sustained but wherever possible accelerated. For its part organized labor must abandon its manifold feather bedding rules and other production-restricting practices which afflict considerable segments of American industry. Further it must give incentive systems of pay, honestly conceived and honestly administered, a fair break. *Management and labor and government and the community at large must collaborate in removing that specter of working one's self out of a job which has been one of the greatest causes of restriction of output.*

The current emphasis by leaders of organized labor on the economic truth that increased output per man-hour is the only road to increased "real" wages is important. The next step is to see that recognition of this truth seeps into the rank and file of labor and industry and becomes the basis of a program of action at the local level. If it does, and quickly, Labor Day, 1946, may mark a tremendous turning point toward sustained prosperity not only for labor but the community at large. If it does not, union leadership will fail in its responsibility and must answer to the American people for the consequences of such a failure.

James H. McGraw, Jr.

President McGraw-Hill Publishing Company, Inc.

THIS IS THE 50TH OF A SERIES



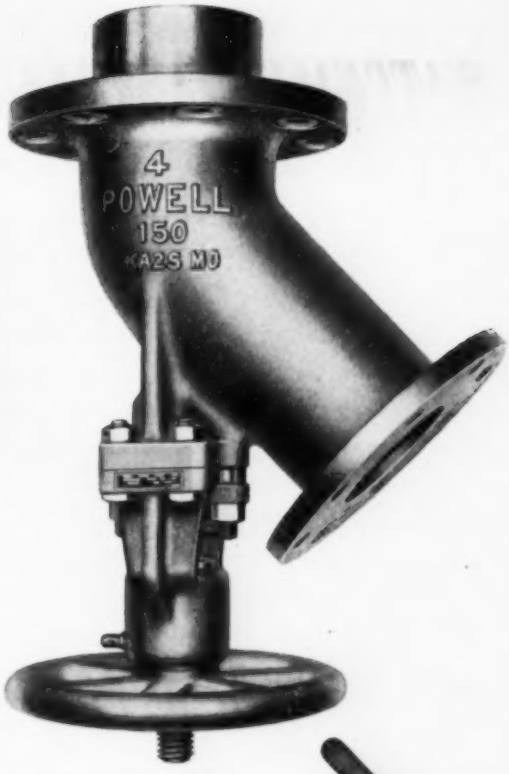


Fig. 2309

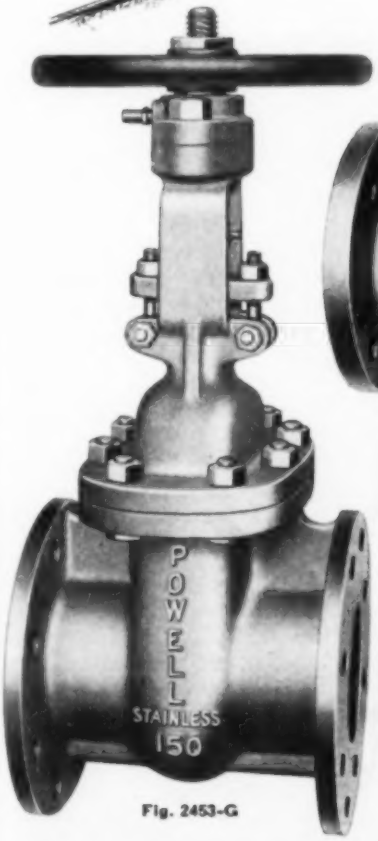


Fig. 2453-G

Fig. 2433-S. S.

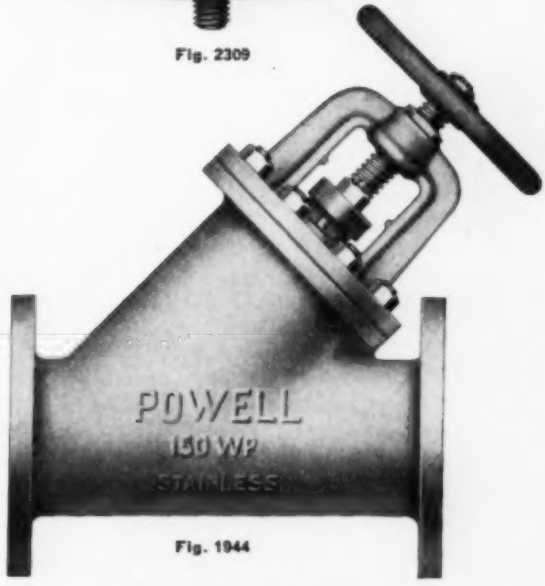


Fig. 1944

Fig. 1969—150-pound Stainless Steel O. S. & Y. Gate Valve with flanged ends, bolted flanged yoke-bonnet and precision fitted taper wedge solid disc. Sizes, ¼" to 2", inclusive.

Fig. 2097—Powell Glass Sight Feed, or Look Box. Made with flanged ends only. Available in bronze, iron, steel, pure metals, special alloys, and rubber lined. Pipe sizes, ½" to 6", inclusive.

Fig. 2429—New, 150-pound Stainless Steel Globe Valve. Flanged ends and outside screw rising stem. Designed to permit streamline flow through the body with considerably less turbulence than encountered in ordinary valves and with greatly reduced pressure drop. Sizes, 4" to 12", inclusive.

Fig. 2453-G.—New, Standard 150-pound Stainless Steel Gate Valve with flanged ends, bolted flanged yoke-bonnet, outside screw rising stem and taper wedge solid disc. Sizes, 2½" to 8", inclusive.

Fig. 2433-S. S.—150-pound Stainless Steel Swing Check Valve, with flanged ends and bolted flanged cap. Sizes, 2" to 12", inclusive.

Fig. 2309—150-pound Stainless Steel Flush Bottom Tank Valve, for attaching to metal tanks and autoclaves. In this design, the disc rises into the tank to open the valve. Available in sizes from ¾" to 8", inclusive.

Fig. 1944—Large size 150-pound Stainless Steel "Y" valve with flanged ends, bolted flanged yoke-bonnet and outside screw rising stem. Sizes, 2½" to 12", inclusive.

VALVES

WATCHING WASHINGTON

R. S. McBRIDE, Editorial Consultant • D. D. HOGATE, Chief of McGraw-Hill Washington Bureau • J. V. HIGHTOWER, Washington Correspondent

Minor changes in Chemical Corps which has replaced Chemical Warfare Service . . . Universities will work with War Department on atomic research . . . OPA order interpreted as freeing all chemical process equipment from price control . . . Office of Technical Services prepares index on technical information obtained abroad . . . Potash distribution will be under allocation . . . Drawings of German mercury chlorine cells now available . . . Delays in granting entry to alien scientists . . . Technical personnel granted deferment in new draft procedure . . . New commodities defined for price control purposes . . . Naval Ordnance Laboratory cornerstone laid

CHEMICAL CORPS CHANGES

SEVERAL major changes, the groundwork for most of which was laid last spring in the general War Department reorganization, have occurred in the Chemical Corps, formerly the Chemical Warfare Service. The entire administrative machinery of the Research and Development Division is being moved from Washington to Edgewood Arsenal, Md., where the laboratories are situated. Col. Charles E. Loucks continues as head of that division.

In Washington the post of Deputy Chief of the Chemical Corps, previously occupied by Col. Lowell Elliott, has been eliminated. In its place has been established the position of Executive Officer, which is occupied by Col. Edward C. Wallington. A few weeks ago there was some uncertainty as to whether Col. Elliott would go to Edgewood Arsenal or to a post in Panama. Col. DeLancey R. King is the new Chief of the Control Division, having succeeded Col. Harry A. Kuhn, who is retiring because of disabilities in line of duty. Col. Kuhn will remain in Washington in consulting work.

FPC PREVIEW ON GAS

FEDERAL POWER Commission has promised to announce, in advance of its final report to Congress, a full statement of its findings and conclusions resulting from the recent natural gas investigation. The statement will be released, possibly in December, far enough in advance of the congressional report to enable those interested in the matter to know what is coming.

FPC said last month that its findings will be reported to all participants in the gas hearings, but did not rule out the possibility that its views will also be made generally available. FPC officials look for a number of requests to be filed by chemical companies using or interested in the use of natural gas. The extent of this demand will influence FPC in its decision as to a general release of its conclusions.

ATOMIC RESEARCH CENTER

WITHOUT awaiting appointment of the Atomic Energy Commission, War Department executives have begun new plans for further research in this field. In August the Manhattan Project announced the selection of Camp Upton, N. Y., as the site of the new research center for nuclear physics of the northeastern area. This Long Island camp site was therefore withdrawn from surplus and assigned to this project.

In order to take advantage of university cooperation, Manhattan Project has made a contract with Associated Universities, Inc., for active work at the new location. Members of that corporation are Columbia, Cornell, Harvard, Johns Hopkins, M.I.T., Pennsylvania, Princeton, Rochester, and Yale. Fundamental investigations will be conducted under this contract, including arrangements by which both faculty and graduate students from the participating schools may use the facilities and contribute to the research of the new center.

EQUIPMENT DECONTROL

OPA ORDER of July 26 dealing with decontrol of prices of chemical process equipment lists many pieces of equipment. However, the items mentioned in amendment 33 to S.O. 129 are by no means exhaustive and limiting. It is the intention of the amendment that all chemical processing equipment is herewith decontrolled. Under the heading "Chemical Processing Machinery" the phrase "not restricted to" means that types of chemical machinery in addition to those specified are decontrolled. OPA considers the entire list of machinery in the field too large to itemize.

In the case of equipment that can be used "as is" in some other industry in addition to chemicals, the fact that such equipment has been decontrolled by reason of its being classified under chemical processing means that the equipment is likewise decontrolled with respect to use in the other industry, as, for instance, beverage manufacture. This is also true even if the machinery can be used in the other industry not "as is" but at an adaptation cost that does not amount to a "substantial modification" in the beverage industry, the clarifier is decontrolled for use in that industry even though clarifiers are not listed in the restricted group of beverage in machinery decontrolled by Amendment 33.

On the other hand, if the cost of adaptation is "substantial" such automatic decontrol does not apply. In that event a piece of equipment decontrolled by the general action of chemical processing machinery is not decontrolled if sold for use in another field in which no action has been taken by OPA to decontrol that particular item.

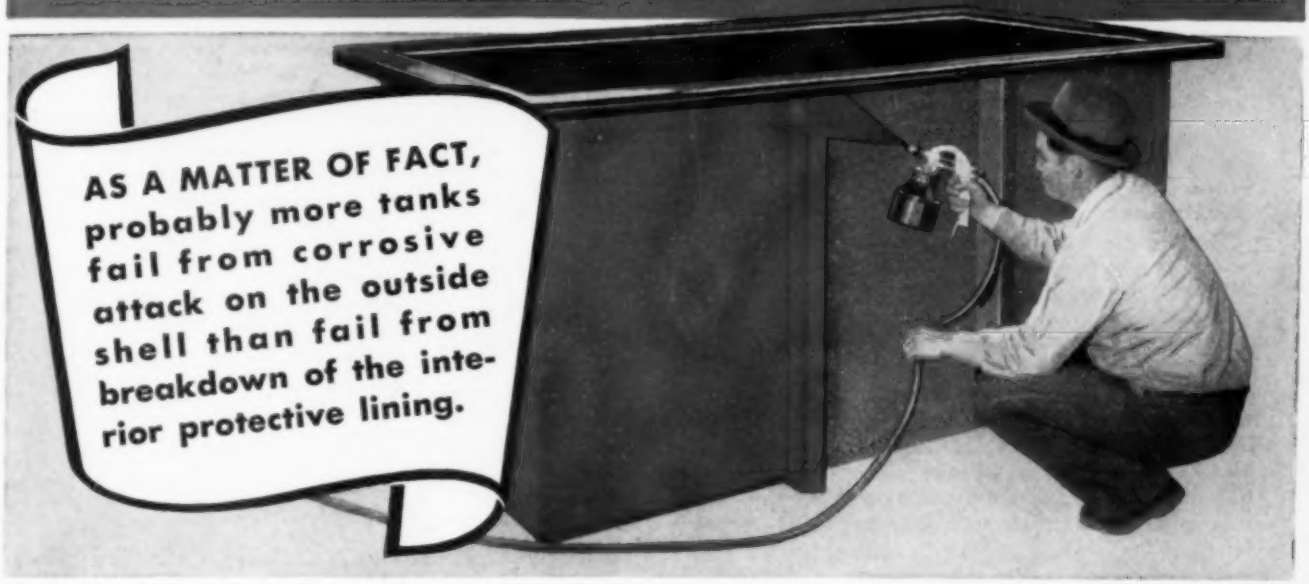
GUIDE FOR OTS PROPOSALS

A GUIDE for the preparation of proposals by all who wish to participate in projects authorized to the office of technical services may be obtained from the industrial research and development division of OTS, Department of Commerce, Washington, D. C. The pamphlet contains full information as to what are the general rules for acceptability of projects, how to prepare estimates and how to figure and present cost items. Outside the government, such groups as colleges and universities, quasi-public research and development institutions, industrial and commercial laboratories and other research or ganizations are eligible to secure OTS contracts.

To secure assistance in determining what types of contracts will be let by OTS. John C. Green, chief of OTS, is setting up an Industrial Research Advisory Council. This group, which probably will con-

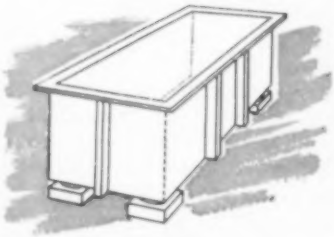
Tank Failure

IS NOT ALWAYS AN "INSIDE JOB"



WHETHER you line your tanks with rubber, plastic, brick, tile or lead, be sure the outside is adequately protected from acid spillage, condensation, fumes, and moisture.

HERE'S HOW:



1st—Wherever possible see that tanks are installed with adequate air space underneath, and that all exterior surfaces are accessible for cleaning.

2nd—Coat all exterior surfaces, *including the bottom,* with Tygon Corrosion-resistant Paint—the *all-plastic* coating resistant to acids, alkalies, oil, water and alcohols. Don't be stingy. Do the job properly. Apply a coat of Tygon Primer, and three coats of Tygon Paint. The cost shouldn't exceed 20c per square foot, including labor and materials.

3rd—Clean and inspect the outside shell occasionally. The glossy Tygon surface cleans easily. If you find a scratch or break in the film caused by carelessness, touch it up with fresh Tygon Paint. The job will be as good as new.

Facts About—

TYGON PLASTIC PAINT

You'll Want To Know

- *May be applied to metal, wood or concrete*
- *Air dries within an hour*
- *Resists acids, alkalies, oils, grease, alcohols and water*
- *Non-oxidizing, will not craze, chalk, check or flake-off*
- *Flexible, tough, resists impact*
- *High dielectric strength*
- *Available in colors: white, black, gray, red, green, aluminum and clear*

PROCESS EQUIPMENT DIVISION

U. S. STONEWARE

Akron 9, Ohio

sist of from four to six men, was authorized last month by Secretary Wallace in an order outlining procedures affecting contracts. The Council is purely advisory and will have no role in the placing of particular contracts.

OTS PREPARES AN INDEX

Soon to be available is a subject index to serve as a key to the increasing mass of technical information buried in the miscellaneous publications listed weekly in the "Bibliography of Scientific and Industrial Reports" issued by the Office of Technical Services in the Department of Commerce. The first issue of the index covers Vol. 1 of the bibliography, which closed in June. Hereafter the index will be issued quarterly and may later be made cumulative.

Subjects are listed alphabetically, and identify the publication numbers of the original reports in which the subjects are discussed, as well as the page numbers in the bibliography where the reports are summarized. Subjects include not only names of processes, chemicals, machinery, fuels, etc., but also names of organizations, such as I. G. Farbenindustrie. Costs of compiling the data have prevented a classification of subject matter in accordance with type of industry or field of interest. OTS officials say that an effort has been made to list all subjects which receive more than a passing mention in the various reports. Coverage extends to all reports and microfilms issued by the Office of the Publication Board, now merged in the OTS.

The first index will run about 1,000 pages, will be priced at not over $1 to subscribers and non-subscribers of the bibliography, and should be ordered from the Superintendent of Documents, Government Printing Office, Washington.

ARMY GRAB MESSES NITROGEN

Army of Occupation needs for nitrogen fertilizer received little attention until early August. Then Washington officials suddenly descended on the nitrogen market to take the next season's needs for Jap and German areas of occupation. A chaotic result followed, and only drastic action of CPA has permitted a restoration of orderly procedures in nitrogen supply. At one stage it looked as though only complete allocation plans would serve to get that result. Even now it is not sure whether the cooperative scheme is going to work fully or not.

The final deal under which the Army will work is about as follows. Major producers of ammonium nitrate will loan the Army quantities sufficient to supply Occupation needs between now and December 31. The Army will repay the producers who supply these quantities one-sixth of the loan in each of January, February, and March, and the remaining half in April. If that return schedule is maintained, the requirements for spring planting will be met in most cases as closely as though the Army had not diverted the nitrogen.

Political factors strengthened the spine of CPA in its guidance of the Army. The first Army program would have made nitrogen practically non-available for fall planting in Florida, the winter-wheat area of Pennsylvania and Ohio, and in other areas where fall use of fertilizer nitrogen is essential for spring crops. In order to avoid such interruptions the Army is being guided in the procurement of nitrogen only where the time and the place are least damaging to adequate plant food supply.

NITRATE PRODUCTION SPEEDED

Army plans to resume production of amonium nitrate at all available arsenals are being pressed. CPA is giving equipment and supply priority where necessary. Interested agent-operators are aggresively at their tasks. Even so, capacity production at many of these arsenals cannot begin until December or January, and a few will be later.

Not negligible in this situation is the political factor. Failure of the Army to get nitrate manufacture up to high levels on schedule will produce repercussions in Congress early next year. Farmers have been asked to sacrifice early nitrogen supply in fertilizer in order that the Army could take its wanted quantities for shipment abroad. Repayment of the goods so loaned before spring planting is vital.

Another question quietly discussed, but discreetly avoided officially, has to do with the impact of this ammonium nitrate on sodium nitrate supply. Synthetic sodium nitrate cannot be made in wanted quantities because of the scarcity of soda ash. Imports from Chile continue far below the quantities desired for agriculture. When the government gets its plants into full operation next winter, it remains to be seen what the ultimate effect on various kinds of nitrogen supply for separate use will be. An inter-commodity battle is sure. Which commodity will win cannot now be foreseen.

FERTILIZER CHEMICALS

Potash distribution will be allocation, with international factors frequently dominating. Combined Food Board took 25,000 metric tons for foreign agriculture, especially for Japan and Korea. Thus American users get less than they wish for both chemical and fertilizer purposes. Complete allocation of nitrogen was contemplated, but became unnecessary when CPA decided to limit its activities to control of War Department takings. Superphosphate production continues at all-time record levels. But even more would be made if sulphuric acid supply were more nearly adequate. Meantime, official demands for greater crops continue. There is no prospect of slow-down in fertilizer chemical usage yet visible.

SYNTHETIC FUELS FILMS

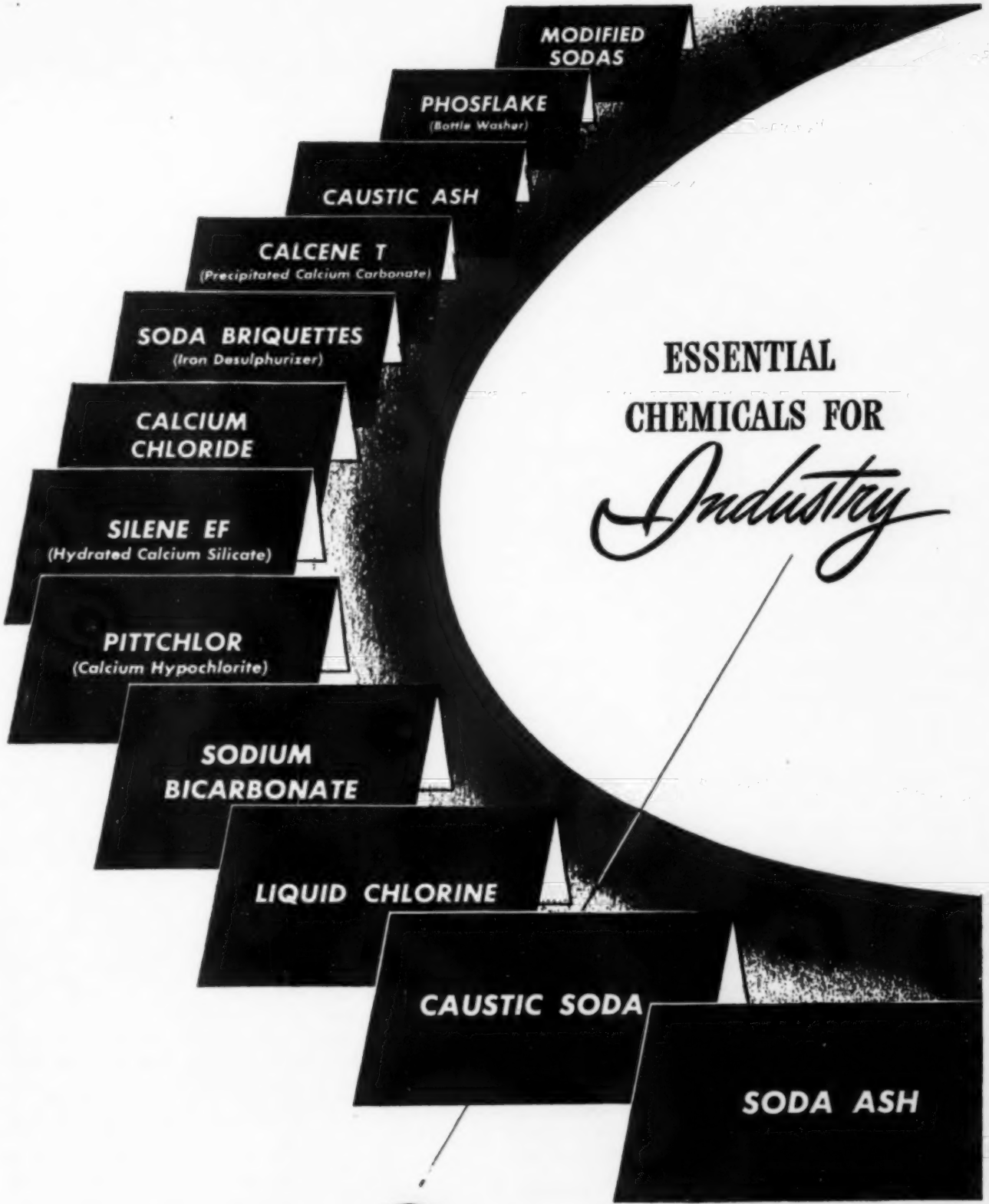
Not generally known is the fact that copies of around 200 reels of microfilms covering information on German synthetic fuels and lubricants collected by the Technical Oil Mission may be secured from the Photoduplication Service in the Library of Congress. The Service furnishes for $5, a microfilmed index showing titles, authors and short abstracts. These films have not thus far been listed in the Bibliography of Scientific and Industrial Reports of the Office of Technical Services.

A typed index also is maintained by the Foreign Synthetic Liquid Fuels Division of the Bureau of Mines. Copies ordinarily have been sent only to addresses on the mailing list of the Petroleum Industry War Council, now dissolved, but may be obtained by request from that division. That agency maintains, for inspections only, a set of all the films and a projector for their use, as well as a file of reports from the Technical Oil Mission and other groups which have investigated the field. Orders for reports are to be placed only with the Office of Technical Services. Orders for films must specify the Technical Oil Mission numbers shown on the Bureau of Mines index and can be placed only with the Photoduplication Service, Library of Congress.

DATA ON GERMAN CELLS

A large collection of drawings covering the horizontal and vertical German mercury chlorine cells is now available at $40 per set from the Manufacturing Chemists Association in Washington. This is the second and more extensive batch of drawings reproduced at cost by the Chemical Alliance, Inc., following investigations by a team sponsored by the Office of Technical Services and the Chemical Corps. When ordering, remittance by check or money order is essential.

The drawings previously released dealt with the 7-meter type of horizontal cell used at Hoechst. The latest group has additional drawings of that type and includes details of 16,000-amp. and 24,000-amp.vertical type cells found at Ludwigshafen and Huls; 14-meter horizontal cells at Hoechst and Leverkusen; and a late model 7-meter horizontal cell at Gensdorf. Along with the chlorine cell drawings are those covering a 2,000-amp. fluorine cell, sodium cells and plant layouts for caustic potash and electrolysis of hydrochloric acid. Reports covering the various groups



ESSENTIAL CHEMICALS FOR *Industry*

COLUMBIA CHEMICALS

PITTSBURGH PLATE GLASS COMPANY
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of drawings have been prepared in Germany and are expected to be available this fall from the Office of Technical Services.

ALIEN ENTRY PLAN DRAGS

How long it will be before American industry has access to the services of German scientists and technologists is anybody's guess, according to indications in Washington. So far the military services continue to monopolize these aliens and have had a free hand in importing them for work on military programs.

In the July issue of *Chem. & Met.* this column reported a broad statement of policy by the State-War-Navy Coordinating Committee outlining certain conditions under which such aliens might be brought to the United States to work in civilian enterprise. The procedure bogged down. Inquiries as to the reasons why were made among officials of the State, War and Commerce Departments who have been concerned with the matter. Explanations pointed to disagreement among government agencies, fear of unfavorable public reaction to the idea of bringing in former aliens, and suspicion that some electioneering congressman might take a swing at any government department involved in the procedure of importing Teutonic brains.

"PROGRESS BEING MADE"

THE statement of policy recently circulated among government agencies "for information and guidance" is being mulled over. As one State Department official says, "Efforts are being made to simplify it and make it workable." The chairman of the State-War-Navy Coordinating Committee dealing with the matter is General John H. Hilldring, Assistant Secretary of State for Civilian Affairs of Occupied Countries.

Washington has a rather dim view as to when a final policy and procedure will be developed. Guesses range from a month to some time early next year. Meanwhile it is one of those "open secrets" that German technologists and scientists are being utilized in civilian activities in other countries which fought the Axis. There is a feeling that if American industry will register its attitude in this matter with the State Department the progress that is being made may be appreciably accelerated.

NEW TRADEMARK LAW

UNDER a new law passed by Congress just before adjournment, trademarks gained increased dignity. But new restrictions are imposed on those who wish to protect their trademarks for a sufficient period to establish them as incontestible. Chemical engineers and executives are expected generally to review the technical aspects of trademark usage, so that their companies do not lose the benefit of this new law. If such technical consideration is not given soon, the sales manager may later find that he has allowed important rights to lapse and that his well-established trade recognition is no longer the defensible property of his own company.

WHO GETS DEFERMENT

ESSENTIAL technical personnel has been recognized by the White House as being so valuable that deferment is to be granted under Selective Service rules as defined latest in much-revised Local Board Memorandum 115. Under the guidance of John Steelman, Assistant President, a policy to this effect was adopted with ultimate concurrence by even zealous General Hershey. The result will be, it is officially forecast, withholding for civilian service the following classes of young men between 19 and 29 who otherwise would be promptly inducted into the armed services.

1. Graduate students in physical sciences and engineering "accepted by an accredited college or university" for M.A. or Ph.D. work, when certified by OSRD.

2. University research workers employed in physical science or engineering, when certified by OSRD.

3. Industrial and institutional research workers in physical science or engineering, not connected with colleges, when certified by OSRD.

4. Teachers in accredited colleges or universities, when certified by Office of Education.

5. Production and transportation workers "whose removal would significantly retard production," especially supervisory, technical, or scientific personnel; and "qualified and irreplaceable production workers," when certified by Civilian Production Administration.

6. Construction workers essential for home building; when certified by National Housing Agency.

Procedure for seeking deferment is about as previously used, starting with representation to local boards, followed by appeals if necessary.

STOCKPILES STARTED

WHEN complete, the stockpiles of strategic and critical materials wanted for preparedness will be worth $2,100 million. This is the estimate of the magnitude of the problem created by the military requirements formulated for the government by the new Army and Navy Munitions Board. That agency, under its civilian chairman, Richard R. Deupree, president of Procter and Gamble, presented the basis for this conclusion during mid-August. Purchasing for the stockpile is beginning at once.

As a nucleus for some parts of the stockpile there have been transferred already $300 million in goods remaining as surplus from World War II. The Board hoped to buy almost as much more each year. Congress decided differently and authorized spending immediately only $100 million.

Purchases with this available appropriation will be made by the Procurement Division of the Treasury Department by competitive bids in the normal government purchasing fashion. Any interesting supplier may make an offering, subject to the "Buy American" limitations which were criticized by President Truman when he signed the Stockpile Act.

Fixed ,but not yet published, are the limits of quantity of each strategic and critical material required for the stockpile. Minimums and maximums determined by the Board will govern buying plans. Until the supplies gathered approximate total needs, it is likely that total quantities to be bought and the status of the stockpile will continue to be confidential information. But the items on the list are well known, since the list has been little, if any, changed since published by Congress in January 1945.

"NEW COMMODITY" RULES

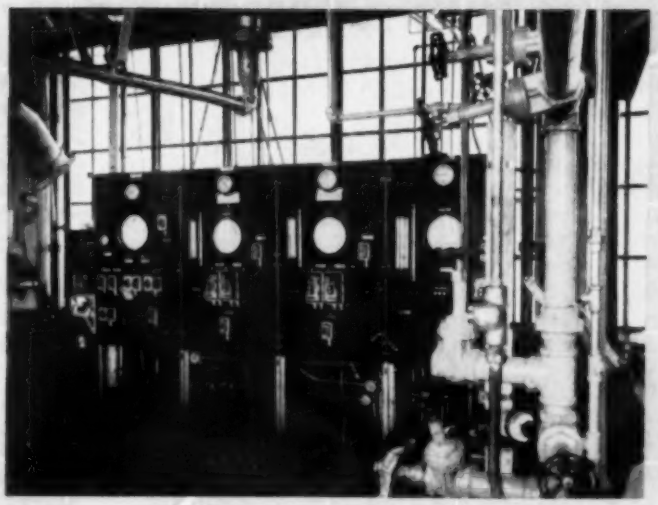
IN OBEDIENCE to the extended Price Control Act, OPA has set the conditions under which "new commodities" may be exempted from control. A new commodity is defined in the act as one which was not commercially or industrially available prior to Jan. 30, 1942. In Supplementary Order 173, OPA has established the following tests which such a commodity must meet: (1) It must be used in the production, manufacture or processing of other commodities, (2) it must either reduce the cost of production, manufacturing or processing of other commodities or increase their life, (3) its use must not increase the cost to the ultimate consumers of the other commodities.

To qualify for an exemption under the order the seller is required to apply for exemption to the Decontrol Division of OPA in Washington. Also required in the application is a statement identifying the commodity, establishing its novelty, and presenting evidence that it meets the tests outlined above.

MINES WORK TO PROCEED

DESPITE cuts in appropriations this year, Bureau of Mines officials are optimistic about the Bureau's ability to carry forward its research and experimental programs in the minerals field. Although the synthetic liquid fuels program got only $5.25 million

Dowtherm on the job!



"Flexible" is the word for this heating-cooling system

Photograph by courtesy of Interchemical Corporation, Finishes Division, Cincinnati, Ohio

High-temperature processing means more than simple heating to this big paint and varnish firm! Some of their products call for complex sequences of heating and cooling . . . and that takes a heating system with *flexibility*. Their answer? A Dowtherm installation for both heating and cooling . . . responsive, easily adjusted to the particular job at hand.

They use a 3,000,000 Btu/hr. Dowtherm vaporizer for heating, and an independent liquid-phase Dowtherm cycle for cooling. Both cycles are available to all three processing kettles. Simple controls permit coordination of the two cycles for a variety of temperature combinations.

Among the advantages of their Dowtherm system, the company points to the following: Larger batches can be processed at a time, less equipment is required, heating is more efficient, and processing more uniform. They feel that over-all operating results have more than justified their switch to Dowtherm.

If *you* are looking for low-pressure heating in the 300°-725° F. range . . . if you are interested in more precise control, simpler operation, lower upkeep costs . . . a Dowtherm system may be your answer. Write today for your copy of "The Dowtherm Story!"

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The high-temperature low-pressure heat transfer medium

DOW

CHEMICALS INDISPENSABLE TO INDUSTRY AND AGRICULTURE

as compared with $7 million last year, other resources available will permit the continuation of the work. Efforts were still being made last month to get the War Department to release some of the facilities at the Missouri Ordnance Works which the Bureau has hoped to operate, but dissident groups in the Army had not reached a decision. The semi-commercial plant at Grand Forks, N. D., for production of hydrogen and carbon monoxide from lignite will operate most of this year.

The new appropriation, $830,000, for petroleum work is an appreciable increase over the previous $580,000. Most of the gain will go into efforts to improve the secondary recovery of petroleum, with the remainder going into fundamental studies of petroleum chemistry and refining. Elsewhere in the minerals field, exclusive of coal, the Bureau has received $560,000, an increase, for its mineral mining work; $1,430,000 for the experimental stations, an increase over the $960,000 last year; $1,000,000 for metallurgical research and pilot plants, drop from the previous $2,600,000 which included certain wartime projects; and $1,700,000 for mineral exploration. The previous appropriation for mineral searches was $2,600,000.

STANDARDS RESEARCH

New investigacions at the National Bureau of Standards should be undertaken shortly through the transfer by the Secretary of Commerce of a special fund of $500,000 to the Bureau under the appropriation act which became effective during July. This transfer was authorized in a paragraph which included the following:

"Provided, That the sum herein appropriated the Secretary may transfer not to exceed $500,000 to the National Bureau of Standards for testing and other scientific studies and expend not to exceed $1,000,000 for temporary employment of persons or organizations by contract or otherwise, for scientific research on new products, materials, material substitutes, and such other subjects and special services determined necessary, including the encouragement of inventive genius, without regard to sections 3709 and 3648 of the Revised Statutes and the civil service and classification laws."

Authorizing the two items for two agencies within one sentence has led to confusion on the part of many seeing this item. The fact is that the $1,000,000 is going to be used by the Office of Technical Services to contract for research to be done outside the government laboratories; but the Bureau of Standards money will be spent by Bureau staff on projects carried out in the Bureau's own laboratories.

It is expected that initially the Secretary's office will suggest a number of projects which are thought to be helpful to little business. The Bureau will try to work out practical ways in which to solve those problems.

WAR CHANGES IN DYES

The Tariff Commission expects to release this month a broad survey of changes that occurred in the dye industry during the war. This statistical study covers the prewar situation, recent changes in production and applications, and postwar developments in the movement of domestic dyes in foreign trade. The Commission has compiled its final report on 1944 production and sales of synthetic organic chemicals and has prepared a corresponding preliminary report for 1945.

PATENT BARRIERS LOWERED

International movement of patented articles has been somewhat limited because of the uncertainty as to the ownership and effect of patents that were German-owned in various countries. A new international agreement has been made by the United States with several nations that eliminates these patents as barriers to such goods movement.

The agreement has been signed already by the United States, United Kingdom, France, and The Netherlands, with the assurance that delegates from Australia, Canada, South Africa, and Czechoslovakia will recommend that their governments sign also. The accord provides that a national of any participating country may get the same non-exclusive, royalty-free license to use patented processes or products as is granted by a nation to its own citizens. This permits sales abroad of American-made goods that would otherwise be in conflict with patent restrictions of the countries of destination.

Office of Alien Property Custodian emphasizes, in making this announcement, that exclusive licenses previously held by non-German owners and all previous rights lawfully acquired by such others will remain undistributed. The accord is intended only to eliminate interference with postwar trade by German ownership of patents.

NAVY LAYS CORNERSTONE

Naval Ordnance Laboratory cornerstone laying proved the occasion on which Secretary of Navy Forrestal could again pledge support of his department to both fundamental and applied research. On August 15 the ceremony officially recognized one of a group of approximately fifty buildings which will make up one of the largest physics research agencies in the world. One of the buildings of nonmagnetic construction will deal with many of the highly-specialized problems of the military. Another will continue the outstanding investigations on proximity fuse, guided missiles, and related basic and applied investigations.

There will be a limited top staff in uniform. But the bulk of the technical work will be done by and under civilians who have been given outstanding recognition by the military services. This recognition extends especially to Army Air Forces work, much of which will be done here in cooperation with the Navy group.

The magnitude of the undertaking is well illustrated by the fact that from $50 to $70 million will be invested in buildings and equipment at an early date. The site itself provides nearly 1,000 acres. The professional staff will, it is expected, includes about 2,000 scientific and engineering workers.

CHANGES IN INTERIOR

After months of critical study of the internal organization of the Department of Interior Secretary Krug is beginning to make certain readjustments. Dominant in his effort is the plan to integrate the Department into a coherent, cooperative agency. Krug frankly criticizes the fact that heretofore the Department has been made up of a considerable number of Bureaus competing with each other for funds, authority, or "rights." Industrial as well as governmental advice is being sought by Krug in the hope that the maximum benefit can come from the changes which he contemplates. Some of these have begun already in the Bureau of Mines. Many others are expected there and elsewhere.

BOOSTING BRAND-NAME GOODS

Token shipments of certain brand-name products made in the United States will be made to Britain as a step toward encouragement of sales of such material in the United Kingdom. This arrangement, announced by Office of International Trade of the Department of Commerce, is intended to permit shipments of about 20 percent of prewar quantities of these goods, so that would be British purchasers can begin to get again at least small quantities of goods that were popular before the war. Token scrip is to issued by the British government as an evidence of permission to import. U. S. manufacturers wishing to take advantage of this arrangement will probably make their deals with the British importers who previously imported their goods.

Most of the types of commodities probably to be handled under this program are brand-name consumer goods; but a few of them are products of process industry, such as carbon electrodes, paints and varnishes, dry batteries, etc.

CHEMICAL ENGINEERING

WITH CHEMICAL & METALLURGICAL ENGINEERING

ESTABLISHED 1902 SEPTEMBER 1946 SIDNEY D. KIRKPATRICK, Editor

Education at the Crossroads

THIS month more men and women entered American universities than ever before in history. They brought with them considerably more than their personal problems in finding places to eat and sleep. Every institution in the country is confronted with more or less serious crises that threaten to break down our system of collegiate education as we have known it in the past. Suddenly this becomes the most important problem of the chemical engineering profession and it behooves all of us to give it our earnest study and support.

With this in mind we recently asked the heads of the various departments of chemical engineering in the United States and Canada for certain statistics needed for a quantitative appraisal of the present situation. The interesting results of that survey are tabulated and analyzed elsewhere in this issue. But we also asked for a listing of a few of the institutions' more pressing problems: "Are they concerned with students, veterans, laboratory facilities, or the getting and holding of capable teachers?" The answers immediately convinced us that the students, and particularly the returning veterans, create no problem except by their very numbers and their keen desire to get the best possible education. Present classes are reported the best in years, more mature, more responsive, and willing to put up with almost anything except poor teaching and inadequate laboratory facilities.

So the really pressing problems, emphasized over and over again in these replies, are the need for more housing and laboratory buildings and the maintenance of competent staffs. Of these the most basic need is for faculty. There are openings for several scores of good men—many at professorial ranks—not only to teach but also to provide research supervision for graduate students. Instructors and graduate assistants are even more urgently required to handle the larger undergraduate classes. Yet most of these jobs go begging.

Most often, of course, it comes down to the matter of money. University salaries have nearly always been lower than those in industry and in the present inflationary period, it is not at all unusual to find young men demanding higher pay than that of professors with ten years experience. Deans of engineering find it difficult to meet industrial competition and still stay within the budgets and salary levels established by academic administrators. There is little or no recognition of the fact that some faculties must cost more than others in today's market for technical manpower.

All this puts some problems—and opportunities—directly up to management of the chemical process industries. Unless it is willing to get along with fewer chemical engineering graduates or those with less thorough training, it must take an active hand in helping education meet its present crisis. In the first place it should immediately cease, desist and condemn the practice of competitive bidding with universities for the services of men who have demonstrated interest and ability as teachers. Secondly, some companies should find it possible, and ultimately profitable, to loan some of their own young men to nearby colleges to serve as graduate assistants and instructors during the present emergency. Finally, there are undoubtedly available in industry and in some of the governmental services able engineers who are reaching the age of retirement and who are excellently qualified to help in the training of younger men and in the supervision of their research projects. We know of several instances where this has already been done with conspicuous success. Wisdom gained through long experience is paid for in the inspiration given and the satisfaction received in having a hand in guiding the future of our profession. Now is a good time for volunteers!

Chemical engineering education needs our sympathetic understanding and support in its present emergency. It is to our self interest to see that these institutions uphold quality as well as provide for quantity production.

R. B. HAMMOND and N. J. JOHNSON *National Carbon Co., Niagara Falls, N. Y.*

Factors Affecting Anode Consumption in CHLORINE CELLS

ON THE BASIS of present figures showing the postwar production rate of chlorine in the United States, it appears evident that many electrolytic chlorine manufacturers will face the prospect of operation over the rated capacity of their cells for some time to come, and that as a consequence they may have to accept some penalties against maximum cell efficiency which these operating conditions usually demand.

NO LETUP IN DEMAND

The peak war potential of rated chlorine capacity in the United States has been placed at about 4,000 tons per day, and predictions made toward the end of the war indicated that a maximum peacetime output equalling 80 percent of war capacity could be expected after reconversion. But chlorine output already exceeds such predictions even before the country has reached well into its peacetime schedule of production. According to the best estimates available, production at the close of the first quarter of 1946 was in the neighborhood of 3,348 tons, or approximately 83 percent of peak war production.

During the war the government built four arsenal plants with a rated chlorine capacity of 300 tons daily and four D.P.C. plants with a rated capacity of 580 tons. Of the combined total of 880 tons, about 430 tons are now being operated by private producers, and other portions of this tonnage are in the process of being either purchased or leased from the government. Present indications are that we actually will use 100 percent of capacity or even exceed wartime capacity between now and the end of 1947.

The small percentage of excess capacity above present production levels which the industry can draw upon in order to meet expected demands is one reason why manufacturers appear to be faced with peacetime operation beyond the rated capacity of their cells.

This condition will be unique in the history of the industry, for while chlorine production has grown enormously since 1921, peacetime capacity has generally managed to stand ahead of demand. Looking back to 1930 we see that the annual production figure was very close to the 200,000 ton mark. Pulp bleaching accounted for the major usage, then came purification of water and sewage. In the next ten years—a period of normal peacetime expansion in the main—production rose to approximately 650,000 tons. The pulp and paper industry was the largest consumer, then was overtaken by chemicals. Projecting this ten year average rate of growth to the year 1950, a normal output of 1,100,000 tons would be expected. But a disproportionate growth of chlorine-dependent chemical processes has sprung from the war to change the picture. Today's peacetime production is at the rate of nearly 1,220,000 tons, and if the 16-yr. average from 1930 to 1946 is projected to 1950, we find a possible 1,450,000 ton figure in the making.

Even though the chlorine market is booming it is highly competitive, and producers, while they push their cells for maximum chlorine output, must still keep an eye out for disproportionate increases in production costs. One such item of expense is anode consumption, and as shown here, the operating conditions that are good for chlorine output are bad for anodes. There is no easy formula that will tell when the extra chlorine is not worth the extra anodes, but here are the variables that the operator must worry about if he is to get the most for his money.—*Editors*

WHERE DOES IT GO?

Most of the chlorine sales are now directed to the following industries.

Aluminum	Phenols
DDT	Pulp and Paper
Ethylene glycol	Solvents
Freon	Synthetic resins
Hypochlorites	Synthetic rubber
Oil refining	Tetraethyl lead

Pulp and sanitation, once major factors in the chlorine market, are now relegated along with incidental users to the minority 25 percent of sales, while organic and inorganic chemical manufacture has come to absorb 75 percent of all chlorine production. The chemical industry has strengthened its position as the number one consumer by developing a large number of new chlorinated products since the start of the war.

The pulp industry is at present using close to 160,000 tons of chlorine yearly, with a significant proportion of this going into bleached sulphate, since every ton of sulphate takes about 200 lb. of chlorine. Inasmuch as there is a decided trend toward substantial increase of bleached sulphate production, the prospect for increasing consumption of chlorine in that industry appears excellent. The most striking development, however, is in the field of organic synthesis. Ethylene glycol absorbed important amounts even before the war, as did the chlorinated hydrocarbons and chlorinated rubber, but products brought to heavy manufacture during the war and figuring largely in the postwar picture are the vinyl chlorides; the allyls, phenols and chlorostyrenes for plastics and resins; aluminum chloride for catalytic cracking in oil refineries; the chloroparaffins for treatment of fabrics, for paints, and as plasticizers; DDT, the Freons, and the silicones.

Of course all chlorine producers do not necessarily sell their product outside their plants. There is a definite tendency on the part of chlorine plants to prepare their own end-products for chlorine, or to make for themselves those products which re-

quire chlorine as an important tool of the process.

The caustic soda picture must also be given consideration when chlorine is under discussion, for the larger part of the nation's caustic production is derived from electrolysis. Here the demand for an increasing purity of caustic is continuous—especially for uses such as rayon production and its equivalent in cellophane production, for mercerization, for the manufacture of fine chemicals, and for soap.

As to market possibilities for the caustic soda that will be a concomitant with high chlorine output, a look at trend lines reveals that, based upon 1930-1940 rates of increase, the 1950 caustic soda requirements will be in the neighborhood of 1,900,000 tons (*Chem. & Met.*, January 1946). This is even higher proportionately than the projected 1,450,000 ton demand for chlorine. The trend has been and continues to be toward more electrolytic caustic at the expense of chemical caustic.

Apparently no major new markets for hydrogen have developed from the war, and output will probably continue to be directed chiefly to ammonia production, with secondary amounts going into fat hydrogenation and hydrochloric acid.

SQUEEZE PLAY

If chlorine prices remain at present levels while wages and material cost continue their upward trend, manufacturing cost considerations will become an increasingly important factor in the postwar picture. New production is already in the planning stage by some companies, but a year or more may elapse before the small margin of capacity between supply and demand is relieved by construction of additional facilities. Then competition for position in the market will be keen and every plant will wish to operate as near capacity as possible, without sacrifice of efficiency, to keep production costs down.

Since cell operation above so-called rated capacity appears inevitable if the industry is to meet the demand for chlorine, producers may have to balance more carefully than ever the variable factors inherent in the overloading of cells.

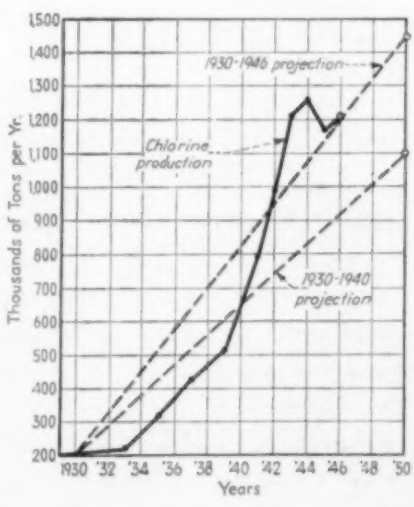
The total cost of the product at the cell is largely dependent upon three factors—power, salt, anodes—with power costing approximately 60 percent and anodes 10 percent of the total. However, over-all cell efficiency is influenced to a very considerable extent by the performance of the graphite anodes used. This subject is to be discussed in some detail in this article.

Under conditions of maximum current efficiency, anode consumption rates may be held to a minimum. When cells are operated at increasing loads in order to increase chlorine output, the anode consumption rate tends to be increased due to a number of factors such as higher cell operating temperatures, an increase in the percentage decomposition of sodium chloride, and others to be discussed later. As the current load approaches the higher levels, current efficiency usually decreases and anode consumption rises—anode consumption rate being in fact a reliable index of current efficiency, provided an anode of recognized standard quality is used. It is generally true that at the higher loads leading to more critical conditions of cell operation, it becomes increasingly difficult to ensure the maintenance of optimum cell efficiencies.

The various cell factors must always be balanced according to the unique conditions faced by each operator and the demands made upon his plant, and no generalized formula can be submitted as to the economics of operation. However, those operating factors which affect the corrosion rate of graphite anodes have been carefully determined under the conditions of control possible in laboratory type diaphragm cells, and it seems appropriate at this time to review these findings for those who may be re-examining the labyrinthine problem of cell variables.

A long term anode research program forms the basis for the anode performance data reviewed here (*Trans.* Electrochem. Soc., vol. 86, p. 127, 1944). The effect of the various factors influencing graphite anode consumption rate, standard known graphite quality being maintained, will be discussed under individual headings to follow.

The experimental cells employed in the laboratory investigation differed in constructional details from those used commercially, and the level of anodic attack was approximately 20 percent greater than that experienced in actual service, but comparative field tests subsequently proved that the basic factors controlling anode oxidation rate in the laboratory units were sufficiently like those in commercial cells to permit a practical interpretation of the laboratory data. However, direct application of the experimental data may be complicated by cell variables commonly encountered in practice.



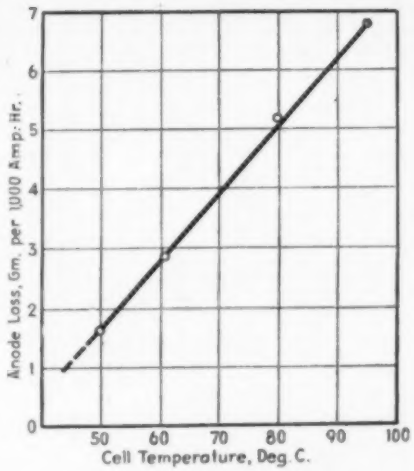


Fig. 1—Graphite anode attack vs. cell temperature

Herein anode corrosion rates are expressed in terms of graphite consumed per 1,000 amp. hr. of cell operation, the weight loss being the "surface weight loss" of the anodes, since the commercial operator is primarily interested in maintaining maximum anode volume for the longest possible operating period so as to gain the advantage of minimum cell voltage.

The four primary cell operating factors controlling anode consumption rate in brine electrolysis subject to investigation were temperature; brine feed rate, which is related to percent sodium chloride decomposition; anode current density; and feed brine concentration. Admittedly, in addition to these four, there are other minor or related factors which can to a greater or lesser degree affect anode consumption.

CELL TEMPERATURE

In the industry, cell operating temperature has been generally recognized as influencing the corrosion rate of the anode. This knowledge, however, has been largely of a qualitative nature and it is felt that the data reviewed here really allows of a quantitative as well as qualitative interpretation. The experimental tests were carried out at the temperatures of 50, 60, 80, and 95 deg. C. with other cell operating factors held constant so as to evaluate only the temperature factor. The results of the test are shown graphically in Fig. 1, where it will be noted that graphite anode attack is increased by 1.15 to 1.20 g. per 1,000 amp.hr. for each 10 deg. C. rise in cell temperature above 50 deg. C. In other words, consumption rate increases 70 to 75 percent of that at 50 deg. C. for each 10 deg. rise above the 50 deg. temperature.

Although a reduction in cell temperature results in a marked decrease in the rate of graphite anode consumption, prac-

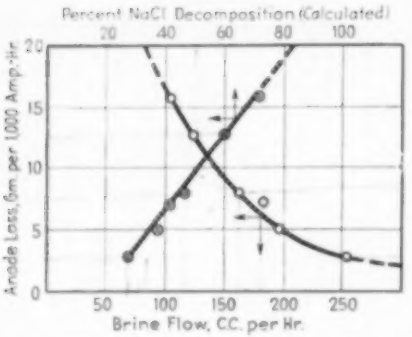


Fig. 2—Anode attack vs. brine flow and percent NaCl decomposition

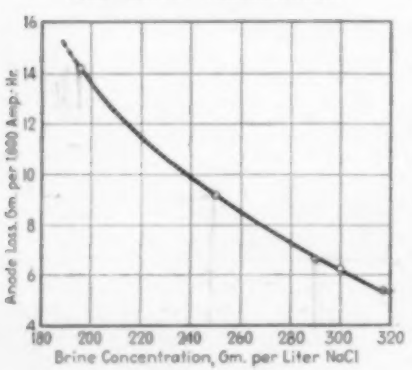
tical operating considerations are such that cell temperatures approaching the boiling point of brine are generally favored in practice. Under such conditions maximum over-all production efficiency is usually realized. Here reference may be made to the influence of temperature on cell voltage. Even in the laboratory units, cell voltage was found to rise approximately 0.1 v. for each 10 deg. C. drop in cell temperature, and with power costs being of the order of 6 to 1 of that for graphite, it is not too difficult to realize why high cell temperatures are generally used in the industry. Optimum cell temperature is of course dictated by the conditions existing in an individual plant.

BRINE FEED RATES

Diaphragm permeability determines in large measure the brine feed or flow rate in most commercial units, and the importance of this factor in influencing graphite anode corrosion rate is borne out by the experimental data illustrated in Fig. 2. It will be noted that a decrease in brine flow rate of the order of 8 to 10 percent increases graphite corrosion as much as 20 to 30 percent. At a constant current load, a drop in brine flow rate through the asbestos diaphragm of the cell increases the percentage NaCl decomposition, and at the same time caustic concentration inside the diaphragm rises, which facilitates the back migration of the hydroxyl ion, which in turn is discharged in greater degree at the anode. Here again, optimum brine feed or flow rate becomes a matter to be determined for a given type of cell at a particular plant. Thus, a rapid brine flow rate may well save graphite, but the resulting drop in caustic concentration of the cell effluent demands increased expenditure for evaporation of cell liquor. It is to be noted that brine flow rate vs. anode attack (Fig. 2) is not a straight line relationship, but that anode consumption rate rises rapidly as flow rate falls below a critical point. In the laboratory experimental cells this critical flow point was about 200 to 225 c.c. per hr., but in commercial cells this may well be quite different. Very likely in practice the break in the curve, or critical point, would fall at a lower level of flow than indicated here.

The point to be stressed is that higher cell loads should be compensated for by increased brine flow rate or by higher feed brine concentrations if the percentage NaCl decomposition and caustic concentration are to be held at recognized optimum levels in terms of anode consumption rate.

Fig. 3—Anode attack vs. feed brine concentration



FEED BRINE CONCENTRATION

The sodium chloride concentration of the brine fed to the cells proved to be a factor of greater than expected importance in controlling graphite anode oxidation rate. A drop in NaCl concentration of as little as 5 g. per l. from the point of saturation (Fig. 3) increased anode attack by as much as 10 percent, and a reduction in brine concentration to 300 g. per l. from 318 g. per l. NaCl increased anode consumption rate by nearly 20 percent. A drop in brine concentration increases the percentage NaCl decomposition just as does a reduced brine flow rate (Fig. 2) or higher cell loads. This factor is deserving of special attention, because variations in brine concentration are not uncommon in practice and the major importance of precise brine control is sometimes overlooked.

ANODE CURRENT DENSITY

Higher anode current density, to be sure, reduces graphite life almost in direct proportion to the increase imposed, but within the current density ranges investigated, the amount of graphite consumed per amp. hr. did not rise but actually showed a slight decrease at the higher current density levels (Fig. 4). In other words, a higher anode current density would not in itself prove detrimental so long as cell efficiency, percentage NaCl decomposition, and cell temperature remained unaffected or constant. In the laboratory cells anode current density was varied by changing the original size of the graphite electrode, hence other cell factors could readily be held constant. In commercial units, however, anode current density is changed by varying the current load, and at once cell temperature, percentage NaCl decomposition, and caustic concentration are affected. All of these latter factors are critical in determining anode consumption rate per pound of cell product produced, as has been shown in preceding discussions.

Graphite as an anode material in brine electrolysis is immune to attack by nascent chlorine, but is subject to slow corrosion by nascent oxygen. Since fundamentally graphite anode corrosion is the result of oxidation, chemical, electrochemical, or both, any cell factor enhancing anolyte oxidizing conditions may be expected to result in more rapid graphite attack and a greater anode consumption rate.

SUMMARY

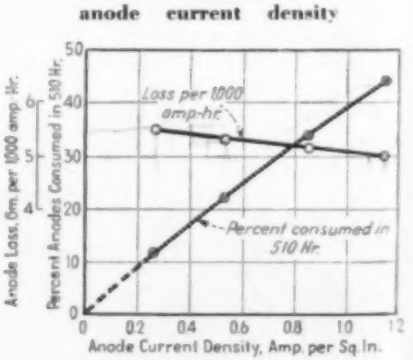
1. In the operating range from 50 to 95 deg. C., other cell factors being maintained constant, graphite anode corrosion rate increases 1.15 to 1.20 g. per 1,000 amp.hr. per 10 deg. C. rise in cell temperature. With 50 deg. C. as a base, graphite attack increases approximately 70 percent at 60 deg. C., 210 percent at 80 deg. C., and 310 percent at 95 deg. C.

2. At constant temperature and current density, brine feed rate becomes a factor of major importance controlling graphite anode corrosion, zero corrosion being indicated for infinite rate of flow and 25 g. per 1,000 amp.hr. (5 times normal) being shown for 100 percent NaCl decomposition or when the rate of NaCl input is equivalent to that decomposed electrically.

3. Even a slight lowering of the NaCl content of the feed brine from the point of saturation leads to a significant increase in the rate of graphite attack, the latter rising rapidly as brine concentration decreases.

4. Anode consumption rate in terms of weight loss per 1,000 amp.hr. decreases slightly with increased current density. However, graphite consumed per unit time increases nearly linearly with rise in current density, the slope of the curve (Fig. 4) decreasing to some extent at the higher values of current density.

Fig. 4—Anode attack vs. anode current density



Chemical Engineering Educational Program Faces Difficulties

A questionnaire to the chemical engineering departments of American colleges and universities reports up-to-date and authoritative information on the situation that exists at present together with a look into the future. The data dealing with the numbers of graduates that may be expected to enter industry should assist industry when making plans for additional chemical engineering manpower for the next few years. The shortage of teaching staffs and the other problems that are handicapping the departments will be of more general interest.—*Editors*

THE CHEMICAL engineering profession is most seriously concerned with the educational programs of the universities and colleges of the United States and Canada. In an effort to obtain up-to-date and authoritative information on the existing situation a questionnaire was sent to the schools. Herewith is a summary and compilation of the data reported by 61 institutions.

The first chemical engineering degree was granted in 1891. By the turn of the century three others of the group were giving B. S. degrees in chemical engineering. In 1920, students could get the bachelor's degree from 38 institutions. The period from 1912 to 1921 witnessed an increasing number of institutions granting the degree for the first time. An average of three was added to the list each of these years.

The first master's degree was granted by one of these schools in 1896. Since that time 48 others have graduated chemical engineers with this degree. A much smaller number of schools have given the Ph. D. degree, in fact, only 26 since 1905 when the first was presented.

HOW CLASSES COMPARE

The last prewar year, 1939-40, found 1889 students of chemical engineering in the graduating classes of the schools replying to the questionnaire. In the same year 255 received master's and 53 doctor's degrees. This year graduating classes totalled only one-third of the 1939-40 figure. While the number of graduate students have not been as large the difference has not been so great due to the fact that many former graduates who had been serving in the armed forces returned for refresher courses at Uncle Sam's expense. It is estimated that next year the graduating class should be doubled or reach two-thirds the size of the prewar class. The departments will not reach their former positions until 1948.

Large increases in undergraduates are expected in the next two years. There were 8,447 in 1946 but it is estimated there will be approximately 11,000 next year and 12,600 the following year. An even larger increase in graduate students is expected, perhaps as much as 50 percent next year. By 1947-48 these schools will probably have 15,000 students in their chemical engineering departments.

Number of Institutions Reporting Award of Degrees by Chemical Engineering Departments

Year	Bachelor's	Master's	Doctor's
1891	1	0	0
1894	2	0	0
1895	3	0	0
1896	3	1	0
1897	4	2	0
1901	5	2	0
1902	6	2	0
1903	7	2	0
1904	8	2	0
1905	11	3	1
1907	12	3	1
1908	17	3	1
1910	18	3	1
1911	19	3	1
1912	23	5	1
1913	24	5	1
1914	26	7	2
1915	29	7	2
1916	29	8	3
1918	33	8	3
1919	35	8	3
1920	38	13	4
1921	42	14	4
1922	43	14	4
1923	45	14	4
1924	46	15	5
1925	47	19	6
1926	48	20	6
1927	51	21	7
1928	52	22	7
1929	53	23	8
1930	55	29	9
1931	55	31	10
1932	56	32	10
1933	56	32	11
1934	56	32	12
1935	56	33	12
1936	58	36	13
1937	58	38	13
1938	59	41	14
1939	59	43	16
1940	60	44	17
1941	60	45	19
1942	61	47	19
1944	61	48	19
1945	61	48	21
1946	61	48	24
1947	61	48	26

The colleges are handicapped by insufficient staffs. As was pointed out in "Technical Manpower Falls Short of Industrial Requirements," pp. 109-111 of the July issue of *Chem. & Met.*, a large number of professors have been in war work and have become acquainted with new projects which interest them permanently. Further, the deans of engineering are finding it difficult to adjust salaries in their departments to meet industrial competition. An accompanying table indicates many vacancies in all classifications from professor to graduate assistants.

Of the 61 schools responding to the questionnaire 44 reported that there were more applicants for admission being received than could be granted. Some stated that they were turning down four or five for every one they were accepting for admission. In all about 10,000 men and women who wanted to study chemical engineering in these schools last year had to be refused admission. Among the most frequently mentioned reasons for this condition were inadequate facilities, and instructional staff.

BAFFLING PROBLEMS

Problems facing the department heads are numerous and many of them extremely serious. The most pressing problem at this time is the obtaining and holding of capable teachers. This is no doubt due to the fact that the rate of pay of teachers who have had experience and are capable, is far below the rate paid in industry to men of equal qualifications. One head of a department made the interesting comment that since the great influx of graduates under the GI Bill will be only temporary he cannot justify adding staff members on a full-time basis with permanent tenure. One cannot find men to fill the faculty without tenure.

In the opinion of another, the most urgent problem in chemical engineering education from a long term proposition is that in some manner or other there should be increased rewards for undergraduate teaching to a point to make this attractive to capable men. In general, chemical engineering departments furnish undergraduate instruction, graduate instruction, research, and consulting service. This man thinks the most important of these, by far, to the country and to industry is the undergraduate instruction and this is the one about which very little is done. There is considerable talk and some action in industry

and government on subsidizing graduate instruction and research, but if a steady flow of competent men with batchelor's degrees is to be maintained, something must be done to make it more attractive to good men to enter the field of undergraduate teaching.

Yet another writes, "I believe that the pressing salary problem in all schools is the relationship between the salaries and experience of the new men and the older men who have stayed on the job. There are plenty of young men who want to go into teaching, but at salaries equal or higher than being paid to professors with ten years of experience. I don't blame the young men, this is their opportunity to establish themselves in a salary scale that is proper. However, the universities are not ready or willing to increase the salaries of their present staff to put them on a comparable basis with those that must be paid to the new man. Some of the older men are "stuck" at their schools, but that is no reason for bringing in a fresh Ph.D. with no experience at a salary almost as great. The problem appears not to be one of getting more staff, but keeping the old staff at salaries comparable to the industrial scale for their experience and abilities. Too often the present staff is retarded by a salary scale common to all academic departments, such as Greek, but it always appears that the school of law and medicine have higher salary scales. This should also be true in chemical engineering."

The numerous veterans who have entered school at such varied times and who must complete different subjects for a degree have forced one school to offer refresher courses as well as subjects not regularly scheduled, and this has increased the teaching load materially.

One of the most serious problems is the accommodation of students applying for admission. One institution accepts all qualified persons who apply. In this case, class schedules throughout the university have been arranged to permit morning, late afternoon, and evening laboratory sections. This requires the employment of additional teachers.

Another department head is handicapped by the difficulty entailed in getting suitable laboratory equipment due to limited budgets and also to inability of equipment manufacturers to supply at this time.

ADMINISTRATION SUPPORT

The difficulty in getting support from administration to do anything different from the way things have been done in the past is troublesome. The faculty is too inbred to be able to make progress in expansion, improvements in facilities, or to make changes in curricula to keep up with trends in chemical engineering education.

Several schools indicate that their most pressing problem is the lack of good mechanics, plumbers and janitors who are willing to work for university salaries. Another reports that they are finding housing for the faculty is a most pressing problem since men whom they have considered to be excellent from all standpoints have refused positions for the reason that the institution could not guarantee housing facilities.

Veterans as a whole are able and conscientious. They have mature judgment and seem to realize the value of the benefits which they are securing.

Several complaints concern the problem of handling and scheduling of mature students whose educational background and experience have been quite varied. It is often a matter of delicate judgment as to how these men may all be fitted into a fixed curriculum in order to assure them of a definite clean-cut chemical engineering education. Administrative problems have mounted, notably those concerned with the selection and handling of new students and the administration of government research contracts.

PRIORITIES

"I believe," writes a dean, "that the position of the universities on the priority listing for war surplus items could be much better than fifth out of six classes. We can only hope that the delivery situation of processed items such as motors in 35 weeks to two years will improve in the near future. If adequate instruction is to be offered to veterans who are very demanding as to what they expect, drastic changes must be made."

Number of Degrees in Chemical Engineering which Reporting Institutions Will Probably Grant

	1946	1947	1948	1949
B. S.	657	1,250	1,820	2,240
M. S.	198	155	620	615
Ph. D.	33	60	100	145

Number of Chemical Engineering Students Last June or Prospectively Registered

	June, 1946	Oct., 1946	Oct., 1947
Freshmen	3,828	4,440	4,500
Sophomores	2,298	3,145	3,450
Juniors	1,345	1,950	2,525
Seniors	1,787	1,300	1,840
Other undergraduates	189	240	290
Sub-total	8,447	11,065	12,600
Graduates	1,485	2,125	2,300
Total	9,932	13,200	14,900

Men Now or Prospectively on Staffs of Departments

	Now Active	Positions Vacant
Professors	114	10
Associate professors	65	22
Assistant professors	78	37
Instructors	69	31
Graduate assistants:		
Teaching	113	61
Research	113	53

New Chemicals Used in English Tanneries

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During the war years England found it necessary to make substitutions among the chemicals used for tanning leather. Some of these proved to be highly satisfactory and are preferred to the materials they replaced. In addition, English tanners have successfully used several new chemicals. Their experiences should be of interest to the American industry.—*Editors*

A RANGE of new chemicals developed by the chemical industry for the modern tannery promises to have an important effect on the quality of the leather produced and the economics of the process of manufacture in Britain and the U. S.

In the preservation of hides and skins, considerable interest has, during the last few years, been taken in the use of the fluorides for the prevention and destruc-

tion of red heat and other halophilic organisms known to cause great damage to hide proteins. Recommended methods of treatment include the soaking of hides in a 0.5-1 percent aqueous solution of sodium silicofluoride prior to salting. In some cases the fluoride is mixed with the salt.

The disinfection of hides is also being carried out in solutions of fluorides, and a mixture of sodium bifluoride and sodium silicofluoride is receiving attention. C. A. Manthei and A. Eichorn, *J. Agric Res.*, 63, 1941, claim that concentrations of these compounds (mixed together in equal proportions) 1 in 5,000 to 1 in 10,000 have been found to kill the virus of vesicular stomatitis in 24 hr. This virus, although non-pathogenic, is closely related to that of the dreaded hoof and mouth disease. Other useful preservatives and disinfectants include sodium fluoride, sodium pentachlorphenoxide, naphthalene and sodium arsenite. Some tanners are using pentachlorphenol for the treatment of tannery plant wooden equipment such as paddles, drums, vats, etc., so as to prevent the growth of fungi, bacteria and other microorganisms likely to affect goods being processed. Pentachlorphenol is only slightly soluble in water and its volatility is extremely low, hence it affords protection that lasts. This preservative is, of course, extensively employed in soaking hides and skins.

DEPILATORIES

Several new depilatories and softening agents have been introduced to the tanner during the last few years and these include sodium sulphydrate, sodium tetrasulphide, calcium sulphydrate and calcium thioglycolate. Probably the most important of the new depilatories is sodium sulphydrate. Use of this chemical enables the tanner to effect a worthwhile economy in the cost of the process as only 60 percent as much of this chemical is required to obtain the same sulphidity as with double strength sodium sulphide. Use of sodium sulphydrate means greater control over alkalinity and therefore less risk of damage to goods being processed. Tanners are, today, making extensive use of sodium sulphydrate admixed with a small percentage of sodium sulphide, the latter being present to increase the alkalinity just sufficient to accelerate unhairing. Calcium thioglycolate promises to assume some importance as a depilatory agent as it does not exert any undue swelling action on the skin proteins. On the other hand this chemical is somewhat unstable and gradually changes to calcium carbonate. Calcium thioglycolate is a white crystalline powder, soluble up to 27 percent in hot water (95 deg.C.) and 7 percent in cold water.

Appreciable development work has been carried out on the use of lime liquor containing protein reduction products and products of micro-organisms for depliation. With the Sebacol process it is claimed by H. Compte, *Le Cuir Tech.*, 30,305, 1941, that the speed of unhairing is increased and it is also easier to obtain controlled liming. The rapidity of the unhairing varies with the concentration of the depliatory agents and the temperature of the liquor, while the swelling depends upon pH of the solution. One criticism levelled against the use of amine preparations for unhairing is that they have a most offensive smell and tend to produce a loose and empty leather.

ENZYMATIC BATES

Turning now to the bating process, there appears to be some doubt, particularly in the minds of British tanners, as to whether enzymatic bates are really necessary, except, perhaps, in the case of goats for glace kid. Work carried out on the use of ammonium chloride in deliming tends to show that this fulfills a dual role by removing the free lime and also the protein degradation products present in the interstices of the fibers. The removal of these products, such as albumoses, has for some time being claimed as the primary purpose of enzymatic bates. By the use of ammonium chloride instead of expensive bate (which incidentally contains this salt) the tanner can effect a considerable reduction in manufacturing costs. Needless to say, this revolutionary departure from orthodox tanning procedure is violently contested in certain quarters.

In the actual tanning processes, increased use is being made of synthetic tanning agents and many new applications have been found for syntans containing sulphonic groups. These agents are used to lighten the color of both vegetable and chrome tanned leathers and also act as levelling agents in coloring chrome tanned stock with acid and direct dyes. In the production of white leathers, synthetic tanning agents based on zirconium or containing zirconium salts have given satisfactory results.

MASKING AGENTS

The employment of masking agents for chrome tanning is now fairly general. Phthalic anhydride and adipic acid, particularly the former, give very good results. Their action may be summarized as follows:

1. The masking agent raises the precipitation point of one bath chrome liquors and ensures a less astringent solution. This means that tanned goods have less wrinkles and drawn grain, which, in the case of calf and goats for glace, is of great importance.

2. The masking agent helps to fill out weak and porous parts of the skin and so produce a more salable leather.

3. It has a levelling effect on the subsequent dyeing operation.

Use of phthalic anhydride in one bath chrome tanning is fairly general in Great Britain but does not appear to have been taken up quite so widely by American tanners.

In the neutralization of chrome leathers, various alkalis are being used. Disodium phosphate gives good results and assists in increaing penetration of dyes (acid and direct) and production of more level colors. Ammonium bicarbonate provides a more uniform pH throughout the cross section of the chrome leather than sodium carbonate and assists the tanner in subsequent operations, particularly dyeing and fat-liquoring.

Various anionically active emulsifiers are now being used in the preparation of fat-liquors and sulphated fatty alcohols are finding increasing employment as wetting agents. Some interest is being shown in the use of chlorinated cyclic hydrocarbons and various plasticizers instead of oils and fats. Experiments carried out with chloronaphthalene indicate that it is worthy of attention as an ingredient of fat-liquors and stuffing mixtures where mineral fats and sulphonated oils are present. Synthetic agents for stuffing pigskins and other leathers have, of course, been in use in Germany for some years. German patent 739,488 refers to leather stuffed with salts or aliphatic or cycloaliphatic amines of high molecular weight of NH_4 compound. Either before or after the stuffing the skin is treated with fat emulsions prepared with the aid of anionically active emulsifiers.

DRYING

In the drying of leather by pasting, increased use is being made of methyl cellulose as an adhesive. Modern continuous drying systems for leather which make use of the technique of pasting on glass plates ensures a high quality of finished full grain leather and maximum area. This adhesive is easy to apply, does not stain and enables the leather to be quickly removed from the base. Incidentally, methyl cellulose has received some consideration as an ingredient of stuffing mixtures where a filling agent is required.

Vinyl copolymers, acrylic resin emulsions and ethyl cellulose are all being used as leather finishing compounds or ingredinets of leather finishes. Polyvinyl chloride-acetate solutions show promise as they possess excellent adhesion to the leather base and the film possesses good flexibility and gloss. Acrylic copolymers are being used as clear finishes or lacquers in place of cellulose esters and the film has a high resistance to moisture vapor.

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Practical Pointers in Design of STORAGE BINS

Existing literature on the design of storage bins is mostly devoted to stress analyses. Long before the engineer can calculate stresses, determine wall thicknesses and specify reinforcing rods in the case of concrete structures, the basic question of size and number of bins and their shape and relative position must be considered. This article discusses some of the fundamental problems involved.—*Editors*

Economic use of available space is one of the principal factors in designing bulk storage bins. It is necessary, then, to design bins of a geometry which will allow the storing of the greatest amount of material per unit space. Obviously, total available space cannot be utilized. For instance, bins designed for draw-off by gravity must have a conical hopper bottom causing considerable space to be wasted. Also, a void will remain at the top of any bin since material, when poured, will repose under a definite angle forming a cone.

Excessive space loss can be minimized by using well designed filling and discharging methods. The simplest method of filling a bin is by raising the material to a high point and to have it gravitate from there into the bin by chute. To prevent possible clogging the inclination angle of the chute α must be greater than the angle of repose of the material γ.

The discharge point of the chute may be on the centerline of the bin or nearer the circumference. Examination of sketch (a) will convince that additional storage space can be gained by having the discharge at the circumference. This conclusion is true only as long as maximum space utlization is the only point to be considered.

Unavoidable waste space in a bin at top and bottom can easily be calculated for a circular bin see (b). To assure positive discharge the hopper cone angle β should be greater than the angle of repose γ, by about 15 deg. If $\pi d^3 h/4$ be considered the total available space, then the ratio of waste space W to total space T is given by $W/T = cd/h$ where $c = .62$ for $\gamma = 30$ deg. and $c = 1.08$ for $\gamma = 45$ deg.

The following table shows the percentage of waste space:

γ	h/d 2	h/d 4	h/d 6
30 deg.	31	16	10
45 deg.	54	27	18

Waste space for a given height h increases in direct proportion with the diameter. To utilize a maximum of space it is advantageous to make the ratio h/d as great as possible. For bins of square and rectangular cross sections conditions are similar.

A vexing problem in design and operation of storage bins is that of arching or bridging in the conical bottom part which may suddenly stop the discharge or cause an irregular flow of material, thus disrupting the process dependent on a uniform feed. The operator is often completely helpless in preventing bridging and in breaking an arch he has to resort to such primitive methods as rapping the walls of the hopper with a hammer or running a poker thru specially provided holes in hopper walls.

ARCHING

None of the known anti-arching means are really positive and the usefulness of some of them is very questionable. One of the more common ways with which a designer pays tribute to this annoying condition is through an offset discharge opening in the hopper bottom. Shown in (c) is a bin with a central discharge opening, the hopper cone angle of which is β, and (d) represents a bin of equal waste space with an offset discharge opening. It is at least very doubtful whether this cone is given less to arching than (c).

If, however, the same angle β is retained in the offset hopper as in (e), then the better performance is due to the fact that additional storage space has been sacrificed and probably the same results could be obtained with a central opening in a bin of equal waste space as in (f).

Sandstrom (*Chem. & Met.* Jan. 1940, p 22) observed that if a straight vertical wall on one side is instrumental in preventing arching then a straight baffle such as a cylinder inside the hopper should have the same effect as in (g).

A reliable way of breaking an arch of pulverized or fine material is by means of compressed air introduced through a pipe extending into the bin as shown in (h). If the air is introduced at regular intervals it may even be effective in preventing bridging.

SEGREGATION

If bulk material consists of particles which vary greatly in size, segregation will take place when it is poured. The larger particles will roll down the cone slope at which the material reposes with the result that during the filling period of a bin, the coarser material will segregate towards the walls leaving the finer material in the center illustrated by (i). When discharging from the bin the ill effect is encountered again. A crater will be formed at the top and the larger particles will roll down the slope, this time into the center, see (j). It has been found that the whole body of material does not move uniformly. At the walls the material remains more or less stationary, while in the center the material will move rapidly in a sometimes well defined slender column, see (j).

Chemical processes usually require that the weight of material be fed at a uniform rate (*Chem. & Met.* April 1946, pp. 125-136). Many feeders, however, serve the material at a constant volumetric rate. Variations in the weight per cu. ft. of the material discharged, which is caused by segregation, can therefore have serious consequences.

A remedy claimed to give good results in preventing segregation consists in a conical baffle being placed above the discharge opening in (k). In addition, it is difficult to conceive of any arching below this baffle and if there is any truth in the

belief that an arch cannot get the proper hold on a straight vertical wall necessary for its existence then an arch cannot develop above the baffle either.

BIN AGING

Most materials undergo physical and chemical changes while being stored. This is especially true of food products and almost any organic substance nearly all of which deteriorate more or less rapidly. But also some minerals and bituminous substances are affected by prolonged storage and exposure to atmospheric conditions. It is, therefore, desirable to have the material move through the bin as a whole body as uniformly as possible. Dead spaces where material may lodge for years while being bypassed by an input of more recent date must be avoided.

This condition is sometimes difficult to meet in case the material is piled up on the ground floor since it is not always possible to add to the heap at one end and withdraw from the other end as in (l). Most common is the flat box type of bin shown in (m), where material is put in at one end and distributed in the bin by an open overhead screw. It doesn't matter much at which end the material is taken out. The draw-off material will always be that which was placed in storage most recently. The only solution in this case seems to be division of the bin into at least two compartments which can then be completely filled and emptied alternately as in (n).

Even in the silo-type of bin, as already explained under segregation, there is considerable bypassing of older material by newer input. In this respect the long slender bin is preferable to the shorter and more compact bin.

Raw materials are often received from a number of suppliers and usually there is considerable variation as to grade and quality of the material. Even in the case of a single supplier, quality of material may vary from consignment to consignment or carload to carload.

Wherever it is necessary to control the quality and grade of material that is fed into a process or packed for shipment a great number of small bins is preferable to a single large one. Material can then be proportioned by drawing from more than one bin to obtain uniformity.

This is even more true in the case of processed materials such as food products which may vary from batch to batch in color, taste and odor. If a great many bins are provided, each one just large enough to receive a single batch, samples can be taken from a bin and if found to be off quality, it can be returned for reprocessing or blending with other batches.

FLEXIBILITY

A process may require the storing of several raw materials, some in large, others in much smaller quantities. The designer is then often tempted to provide bins accordingly of various sizes. A distinct disadvantage of such arrangement is a lack of flexibility. The relative amounts of materials used may not be the same very long. Expansion of production and shifting to other processes may render the particular set-up inefficient. If all bins are of the same size and a number of bins are used for the material required in great quantities, while only one or a few bins are used for other materials, a rearrangement of the storaged goods relative to each other can easily be obtained.

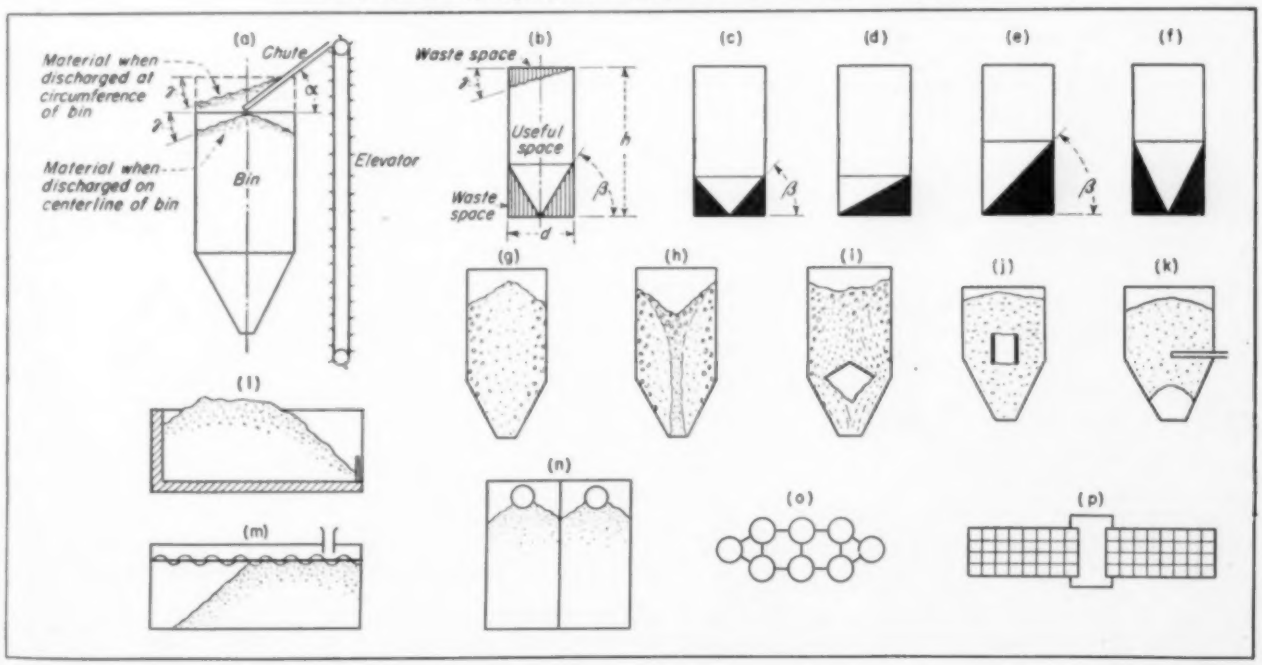
CONSTRUCTION COST

From whatever angle the problem is viewed, whether economy of space, segregation, aging, flexibility of operation, the tall slender bin is apparently vastly superior to a squat one. Just how slender to make a bin seems to be a question of cost which is largely determined by the amount of construction material required.

As far as a single unit is concerned, the bin of circular cross section is obviously least expensive. Such bins are widely used as farm silos and long years of development have established a certain favorable ratio of height to diameter which is said to range from 3.5 to 4.

Unfortunately the circular cross section does not combine readily to a group. There is always objectionable interspace, no matter how a number of circles are patterned together. Sometimes the interspaces are used as bins, resulting in somewhat bewildering layout and additional expenses for conveying equipment as in (o). Bins, into the design of which has gone more intensive study and careful planning than is ordinarily accorded a bin as an adjunct of a mill, are the grain elevators. Due to the huge size and number, they have undergone a steady progressive development. (p) shows a typical layout of a grain elevator. Square bins grouped together as shown make up two wings of the building with the central portion housing the elevator equipment. The ratio of height to diameter of the individual bins is usually around 6 to 7.

Economy results from properly designing bulk material storage bins



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GAUSS'S FORMULA

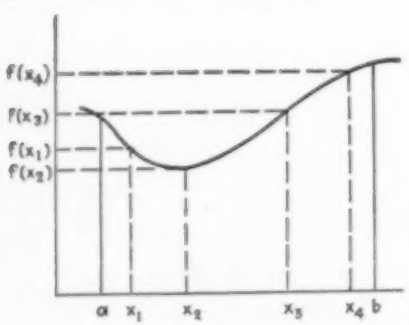
In Chemical Engineering Calculations

Known to mathematicians, but seldom to engineers, Gauss's formula enables accurate integration of any curve to be accomplished quickly by the use of numerical constants substituted in a formula. The method applies whether or not an equation can be fitted to the curve. It is more rapid than graphical integration and can readily be adapted to routine calculations in fluid flow, absorption, distillation, crystallization.—*Editors*

GAUSS'S METHOD of numerical integration, an especially valuable tool in chemical engineering work, is apparently not generally familiar to engineers. It can be used advantageously to facilitate integration which occurs frequently in problems in fluid flow, absorption, distillation, and crystallization, and offers attractive possibilities for engineering test work. Since the method requires mere substitution in formulas and their arithmetic solution, it is more convenient than the tedious and time-consuming graphical method of integration and is sufficiently accurate for most engineering work. As examples of its use the simplifications obtained in the measurement of fluid flow with pitot tubes, and in evaluating the integral for the number of transfer units in absorption problems are demonstrated below. A comparison with results obtained by the customary graphical methods is given for both applications and other uses are suggested.

In Gauss's method of integration predetermined values along the abscissa are used. The related values of the ordinate are multiplied by the corresponding Gaussian constant. The sum of these products multiplied by the over-all length of the intervals is the desired integral. This method is analogous to the well-known Simpson's rule, except that in the latter the intervals are equal and the constant factors are all simple integers. The crux of the Gaussian method of integration lies in the location of the ordinates for any given range. Gauss's method applies to any curve, whether or not there is an equation for it, and the results are more accurate than other methods using the same number of points; in fact, using only four ordinates this method gives the exact integral for a seventh degree equation. Any number of points may be used but for most engineering work four points give sufficient accuracy. In some cases as few as two points can be used.

Fig. 1 — Typical curve showing how x values are selected



If the definite integral $\int_a^b f(x)\,dx$ is to be computed from a given number of values of $f(x)$, just where should these values be taken in order to get a result of the greatest possible accuracy? In other words, how should the interval (a,b) be subdivided so as to give the best possible result? This is what Gauss determined in developing his formula which is

$$\int_0^1 \phi(u)du = K_1\phi(u_1) + K_2\phi(u_2) + \ldots + K_n\phi(u_n) \qquad (1)$$

where $u_1, u_2 \ldots u_n$ are the points of sub-) division of the interval $u = 0$ to $u = 1$. This general equation can be transformed into forms valid over other ranges. For a range in variable x from a to b, we have

$$x = a + (b-a)u \qquad (2)$$

and the corresponding values of x are $x_1 = a + (b\text{-}a)\,u_1$, $x_2 = a + (b\text{-}a)\,u_2$, etc. The value of the integral $\int_a^b f(x)\,dx$ is therefore

$$\int_a^b f(x)dx = (b\text{-}a)\,[K_1 f(x_1) + K_2 f(x_2) + \ldots + K_n f(x_n)] \qquad (3)$$

Values of the constants u and K from $n = 2$, to $n = 7$ appear in Table 1.

To evaluate an integral by this method it is only necessary to substitute in and solve Equations (2) and (3). If, for example, it is desired to find the area under the curve shown in Fig. 1 from a to b by using four points ($n = 4$), x_1, x_2, x_3, and x_4, the predetermined values along the abscissa are first calculated in Equation (2) by substituting the values for a, b, and the con-

NOMENCLATURE

- a = Interfacial surface per unit volume, sq. ft. per cu. ft.
- D = Size of openings of sieve, cm.
- G = Mols of solute-free gas per hr., lb.-mols per hr.
- h = Height of packed tower, ft.
- k_a = Transfer coefficient for gas phase, lb.-mols per (hr.) (sq. ft.) (driving force in partial press.).
- L = Mols of absorbing liquor passing through tower per hr., lb.-mols per hr.
- m = Slope of equilibrium curve.
- n = Number of transfer units.
- N_R = Molecular weight ratio of absorbable gas to inert gas.
- $(N.T.U.)_a$ = Number of transfer units based on gas film.
- P = Total pressure, atm.
- Q = Volume flow rate, cu. ft. per sec.
- R = Radius, ft. or in.
- v = Velocity, ft. per sec.
- V = Volume of tower, cu. ft.
- W = Weight.
- x = Mol fraction in liquor.
- X = Pounds of absorbable material per pound pure absorbing liquid.
- y = Mol fraction in gas.
- y^* = Mol fraction in equilibrium with liquid.
- Y = Pounds of absorbable material per pound of inert gas.

Subscripts

- i refers to gas-liquid interface.
- p refers to product.
- s refers to seeds.
- 1 refers to inlet condition.
- 2 refers to outlet condition.

Table I—Constants for Various Points in Gauss's Method of Integration*

Number of Points, n	u_1	u_2	u_3	u_4	u_5	u_6	u_7
2	0.2113	0.7887					
3	0.1127	0.5	0.8873				
4	0.0694	0.3300	0.6700	0.9306			
5	0.0469	0.2308	0.5	0.7692	0.9531		
6	0.3377	0.1694	0.3807	0.6193	0.8306	0.9662	
7	0.0254	0.1292	0.2971	0.5	0.7029	0.8708	0.9746

Number of Points, n	K_1	K_2	K_3	K_4	K_5	K_6	K_7
2	0.5	0.5					
3	0.2778	0.4444	0.2778				
4	0.1739	0.3261	0.1739	0.3261			
5	0.1185	0.2393	0.2844	0.2393	0.1185		
6	0.0857	0.1804	0.2340	0.2340	0.1804	0.0857	
7	0.0647	0.1399	0.1909	0.2090	0.1909	0.1399	0.0647

* For values of these constants to 10 decimal places see Scarborough[3].

stants u_1, u_2, u_3 and u_4. Then $f(x_1)$, $f(x_2)$, $f(x_3)$ and $f(x_4)$ are read from the graph (Fig. 1) and substituted into Equation (3) together with the Gaussian constants K_1, K_2, K_3 and K_4, and the over-all length of the interval $(b\text{-}a)$. The solution of Equation (3) gives the value of the integral.

PITOT FLOW MEASUREMENT

In engineering test work where observations are made at frequent intervals and the average value of a variable is desired, Gauss's method of integration can be used to advantage. One example is its application to flow measurement with pitot tubes where it simplifies the necessary traverse. This use of Gauss's formula is given by Sherwood and Reed[2] and Perry[3].

Since the velocity through a round pipe varies radially, the flow is given by

$$Q = \pi \int_{-R}^{R} v r dr = \frac{\pi R^2}{2} \int_{-1}^{1} v d(r/R)^2 \qquad (5)$$

The integration may be obtained by plotting the velocities as obtained with the pitot tube vs. r^2/R^2 and integrating graphically. The method usually used is to measure the velocity at ten points representing half-rings of equal areas, in which case the average velocity is one-tenth the sum of the ten measured velocities. It will be shown that a simplification is accomplished by using Gauss's formula requiring only four points and eliminating the graphical integration.

Fig. 2—Equilibrium curve and operating line for absorption tower discussed in text problem

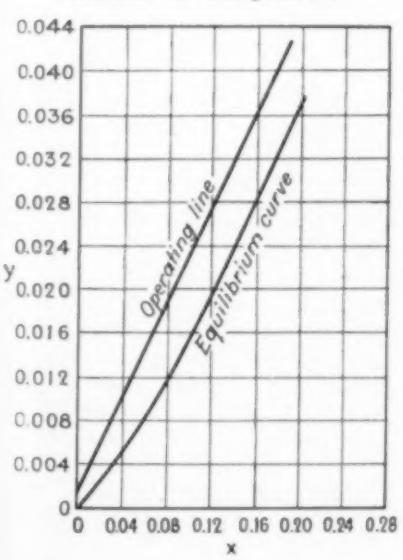


Table II—Comparison of Average Velocities Calculated From Graphical Integration, 10-Point Traverse, and 4-Point Gauss for Flow Measurement with Pitot Tubes†

Fluid	Pipe Diam., Ft.	Avg. Velocity, Ft. per Sec. — Graphical Integration	10-Point Traverse	4-Point Gauss
Blast furnace gas..	6.33	51.2	52.1	51.9
Air.....	2.17	62.0	62.3	61.7
Water.....	0.33	10.9	10.9	10.8
Sulphur burner gas.	1.46	23.8	23.8	23.7
4.4 percent HCl in air.....	0.83	27.5	27.6	27.6

† From Sherwood and Reed[2].

Using the right hand member of Equation (5) and Equation (2) we have $(r/R)^2 = a + (b\text{-}a)u = -1 + 2u$.

Then $(r_1/R)^2 = -1 + 2(0.0694) = -0.8612$
$(r_2/R)^2 = -1 + 2(0.33) = -0.34$
$(r_3/R)^2 = -1 + 2(0.67) = 0.34$
$(r_4/R)^2 = -1 + 2(0.9306) = 0.8612$

and $r_1 = -0.928R$, $r_2 = -0.583R$, $r_3 = 0.583R$, and $r_4 = 0.928R$, where r_1, r_2, etc., are the points along the diameter at which the corresponding velocities v_1, v_2, v_3 and v_4 are taken with a pitot tube. The distances are measured from the center and the minus signs denote direction, $-0.928R$ being on one side of the center and $0.928R$ on the opposite side. Substituting in Equation (3) and putting in the constants

$$Q = \frac{2\pi R^2}{2} [0.1739 (v_1 + v_4) + 0.3261 (v_2 + v_3)]$$

or the average velocity

$$v_{avg.} = 0.1739(v_1 + v_4) + 0.3261 (v_2 + v_3) \qquad (6)$$

An illustrative example follows.

Example—Air is being blown through a 12-in. diameter pipe. It is desired to make a four-point traverse with a pitot tube to determine the average velocity in the pipe. At what distances along the horizontal diameter should the readings be taken to give the best possible results?

$r_1 = -0.928R = -0.928(6) = -5.57$ in.
$r_2 = -0.583R = -0.583(6) = -3.5$ in.
$r_3 = 0.583R = 0.583(6) = 3.5$ in.
$r_4 = 0.928R = 0.928(6) = 5.57$ in.

or the distances from the pipe wall are 0.43 in., 2.5 in., 9.5 in., and 11.57 in.

If the velocities measured at the above points are as given below, calculate the average velocity in the pipe: At r_1, $v_1 = 53.0$ ft. per sec.; at r_2, $v_2 = 77.5$ ft. per sec.; at r_3, $v_3 = 78.4$ ft. per sec.; and at r_4, $v_4 = 62.5$ ft. per sec. Substituting in Equation (6), $v_{avg.} = 0.1739(53.0 + 62.5) + 0.3261 (77.5 + 78.4) = 70.9$ ft. per sec. The average velocity in the pipe is 70.9 ft. per sec.

A comparison of average velocities calculated by Gauss's method, graphical integration, and ten-point traverse is given by Sherwood and Reed[2]. Some of these are shown in Table II. These authors report an average percentage error as compared with graphical integration of 0.25 percent for the ten-point traverse and 0.8 percent for the four-point Gauss method.

NUMBER OF TRANSFER UNITS

In the design of an absorption tower it is necessary, for example, to evalute the integral in the equation

$$\int_{Y_2}^{Y_1} \frac{dY}{Y - Y_i} = (N.T.U.)_a = \frac{Pk_Ga\,V}{N_R\,G}$$

The conventional method of evaluating the integral is to plot $1/Y\text{-}Y_i$ vs. Y and graphically compute the area under the curve between the limits Y_1 and Y_2. This method is tedious and time-consuming. The following example shows how evaluation of the integral can be simplified using Gauss's formula.

Example—Calculate the number of transfer units, $(N.T.U.)_a$, for an absorption tower by evaluating the integral

$$\int_{Y_2}^{Y_1} \frac{dY}{Y - Y_i}$$

where $Y_2 = 0.0008$ and $Y_1 = 0.0337$. The equilibrium curve and operating line for the system are given in Fig. 2.

Let Y_I, Y_{II}, Y_{III}, and Y_{IV} be the four predetermined values of Y to be used in Gauss's formula. Then from Equation (2) $Y_I = Y_2 + (Y_1\text{-}Y_2)u_1$, $Y_{II} = Y_2 + (Y_1\text{-}Y_2)u_2$, $Y_{III} = Y_2 + (Y_1\text{-}Y_2)u_3$, and $Y_{IV} = Y_2 + (Y_1\text{-}Y_2)u_4$. Therefore,

$Y_I = 0.0008 + (0.0329)(0.0694) = 0.0031$
$Y_{II} = 0.0008 + (0.0329)(0.33) = 0.0117$
$Y_{III} = 0.0008 + (0.0329)(0.67) = 0.0228$
$Y_{IV} = 0.0008 + (0.0329)(0.9306) = 0.0314$

Table III—Comparison of Results Obtained by Graphical Integration and 4-Point Gauss for $(N.T.U.)_G$

System	$(N.T.U.)_G$ Integra— Graphical Integration	4-Point Gauss
H_2O in air-H_2SO_4	2.26	2.31
SO_2 in burner gas-H_2O	19.93	19.85
H_2O in air-H_2SO_4	1.76	1.79
H_2O in air-NaOH	8.76	8.87
H_2O in air-NaOH	2.60	2.59

from Fig. 2 the corresponding values of Y_i are $Y_{iI} = 0.0010$, $Y_{iII} = 0.0060$, $Y_{iIII} = 0.0152$, and $Y_{iIV} = 0.0238$. The Y and Y_i values thus found are substituted into Gauss's formula (Equation 3) with the constants given and the following equation results.

$$\int_{Y_2}^{Y_1} \frac{dY}{Y - Y_i} = (Y_1 - Y_2)\left[0.1739\left(\frac{1}{Y_I - Y_{iI}} + \frac{1}{Y_{IV} - Y_{iIV}}\right) + 0.3261\left(\frac{1}{Y_{II} - Y_{iII}} + \frac{1}{Y_{III} - Y_{iIII}}\right)\right] \quad (4)$$

or

$$(N.T.U.)_G = 0.0329\left[0.1739\left(\frac{1}{0.0031 - 0.0010} + \frac{1}{0.0314 - 0.0238}\right) + 0.3261\left(\frac{1}{0.0117 - 0.0060} + \frac{1}{0.0228 - 0.0152}\right)\right] =$$

6.77 = the number of transfer units.

In a similar manner, Gauss's formula can be readily applied to the integral for more concentrated systems

$$\int_{Y_2}^{Y_1} \frac{(N_B + Y)(N_B + Y_i)}{Y - Y_i}\, dY,$$

to cases where the liquid film is controlling $(N.T.U.)_L$, for calculating the height of a transfer unit in packed distillation columns from the equation

$$H.T.U. = \frac{h}{n}\int_{y_2}^{y_1} \frac{dy}{y_1 - y^*}$$

and also for the crystallization equation

$$W_p = \int_0^{W_s} \left(1 + \frac{\Delta D}{D_s}\right) dW_s \text{ (ref. 1)}$$

Other simplifications for determining the number of transfer units designed to eliminate graphical integration such as the logarithmic mean driving force method[4] or the plotting of $N.T.U.$ vs. $(y_1 - mx_2)/(y_2 - mx_2)$ at various ratios of mG/L (ref. 2) are limited by the fact that the equilibrium curve must be a straight line in the range considered and an additional limitation on the plot is that it holds only for dilute systems. Gauss's formula will hold regardless of equilibrium line curvature and regardless of concentrations.

Results obtained by the proposed method using Gauss's formula are compared in Table III with those obtained by graphical integration for several absorption systems.

In conclusion the author wishes to acknowledge with thanks the assistance of Dr. V. V. Latshaw in connection with the calculations.

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Needed: Standard Cost Estimating Data For the Process Industries

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Author Eckhardt makes a valuable suggestion: the accumulation, correlation and publication by a central agency of preconstruction cost estimating data on process equipment and process operation. The source of these data would be the chemical engineers who have already secured them for their own use. Their reward for cooperating would be the data of other engineers who had also cooperated. Such data are badly needed and a cooperative method of assembling them appears to be the only practical way. *Chemical Engineering* gladly offers to undertake the job of correlation and to that end urgently invites the correspondence, suggestions *and/or data* of every engineer who agrees with the aims of the plan.—*Editors*

ALTHOUGH IT is a truism that the engineer always strives to accomplish his objective at the lowest possible cost, it is obvious that most work of the chemical engineer is accomplished without converting the results to a monetary basis. The fact remains, however, that some accomplishments of the chemical engineer, at one time or another, must be compared on this basis. It is no difficult problem to calculate costs for an existing process, since cost accountants have a standard procedure for dealing with actual costs. The chemical engineer in development or consulting work is interested primarily in another phase of cost accounting—preconstruction cost accounting. He is interested in historical cost records only as a basis for estimating future costs.

When the young chemical engineer for the first time tries to estimate costs for a proposed process, he is frustrated by the paucity of cost data available. The experienced engineer also knows that estimation of costs is laborious, slow, and often of doubtful value, since the subject of costs has not been developed to any appreciable extent in chemical engineering, and many of the data come from personal or unpublished sources. It is granted that the ingredient cost for any process or operation is obtained easily from current market prices. Nevertheless, in chemical engineering there is no extensive source of data for operating and equipment costs such as is available in the standard cost handbooks of civil engineering. It is time that the chemical engineer had a standard source for cost data.

PRESENT DATA SOURCES

The principal text books in chemical engineering present the subject almost without any reference to equipment or operating costs. An exception to this rule is the recent book, "Chemical Machinery," by Riegel[1]. This book has been well larded with prices for typical equipment, although no separate treatment of costs has been undertaken. Similar cost data are also found in Perry's "Chemical Engineers' Handbook"[2] and in "Unit Operations Laboratory Equipment" by Zimmerman and Lavine[3].

Altogether there are probably only two books published in this country in the field of chemical engineering which devote a section to the subject of preconstruction cost accounting: "Chemical Engineering Economics," by Tyler[4] and "Chemical Engineering Plant Design," by Vilbrandt[5]. A number of articles on cost have appeared in various journals from time to time. The most comprehensive treatment is that given in the article by Bliss, "The

Costs of Process Equipment and Accessories"[6]. A very useful publication for a quick compilation of a cost estimate for a proposed process is "Report of Investigations," R. I. 3815 of the Bureau of Mines[7]. Part I of this paper contains the detailed capital and operating costs for proposed electrolytic manganese plants for a capacity of 10 and 40 tons daily.

A good beginning has been made, and this work should be carried further. The writer feels that most progress will be made by the combined contribution of many chemical engineers, rather than by the occasional published work of individuals. The reason for this is that cost information is the individual holding of every practicing chemical engineer. Every engineer has in his files quotations on industrial equipment of all types. Furthermore, nearly every engineer has some operating cost records, some of them representing many hours of work, but disclosed perhaps only in house messages to his immediate superior. On the other hand, the experience of compilers of cost data who have gone to the primary source of data for equipment costs—the equipment manufacturer—has been, on the whole, unsatisfactory. The manufacturers are not willing to disclose price data except on actual quotation in most cases.

DIFFICULT BUT POSSIBLE

There is no question that the subject is difficult, but the fact that prices vary widely from day to day, or from dealer to dealer, does not prevent the compilation of useful cost data. No industry is subject to wider fluctuations in prices of material and labor than the building industry, yet it operates to a great extent on a preconstruction cost accounting basis. How useful is the practical figure of $10 per cubic yard of concrete, even though the cost of pouring concrete varies so widely! Similarly, in chemical engineering we have the practical standard cost of 50c. per 1,000 lb. of steam. More such standard cost figures should be established for the process industries. Besides expediting the work of cost estimating, the establishment of recognized standards of costs would have the further advantage that it would tend to narrow the range for quoted prices. Doubt in the usefulness of such data springs from ignoring the commonplace mode and emphasizing the sports at either end of the probability curve.

For most preconstruction cost accounting purposes over-all cost data are preferred to itemized costs of every piece and part that goes into an assembly. It is surprising how close to the ultimate real cost a skilled estimator can come using over-all cost data. Extensive detailed preconstruction cost calculations are seldom justified; moreover, in the early stages of development when the proposed process is in a state of flux, such calculations would be interminable. Even assuming that the flow sheet has been completed, it is obviously impossible to estimate the cost of piping by itemizing every valve, fitting, and piece of pipe before the layout drawing is made. Yet one cannot wait until the layout drawing is finished.

DOLLARS PER DOLLAR

How then can an estimate of piping cost be made? Obviously, the cost of piping must bear some close relation to the cost of the installed equipment. A little consideration will show that it must be possible to determine fixed ratios for such costs as a function of the size of the plant for each class of process operation or industry, such as petroleum refining, high pressure synthesis, heavy chemicals, and so on. The possible scope for such a method of compilation is illustrated by citing some hypothetical titles for cost correlations:

Ammonia Synthesis: *Cost of Instruments (in percentage of total plant cost) vs. Plant Capacity.*

Fine Chemicals: *Cost of Piping vs. Total Plant Investment.*

These cost correlations could be presented best by a graphical method. At the present time the practice is to plot cost of equipment against size or capacity, showing the curves for the average and also the maximum and minimum range of costs. A better way would be to plot a "scattergram" of cost data, omitting all curves. This would avoid giving undue weight to the less frequent cases; moreover, the plot can be always kept up to date merely by adding additional data, without the necessity for changing earlier entries. Without making any detailed calculations, an estimator could determine intuitively the probable cost of a unit in question.

The principal reasons for inaccuracies arising from over-all cost estimates are due to the factors of changing prices, variations in details among units of the same type, accessories, and installation charges. However, by following a standard procedure, errors from these sources can be reduced to a minimum. Above all, it is essential that cost data bear a date. This is necessary particularly in these times of rapidly rising prices. A standard price index should be established for all equipment; tentatively the wage index and commodity index current in the United States might be adapted for this purpose. By the use of such an index, cost data should be valid over long periods of time.

Estimated operating cost is an important item in determining the probable mill cost of product in a proposed process. Since the wages of a typical plant workman represent a capitalized value of about $30,000, exclusive of overhead charges, it is obvious that the cost of labor is often the critical factor when material cost is low. There is very little published information on labor costs for operating typical processing equipment.

Operation costs could be compiled similarly as correlation diagrams. For example, let us take the problem of determining handling and storage costs. Assume an estimate is wanted for the cost of handling and storing lignite for an annual consumption of 50,000 tons. This falls in the class of materials that can be stored outdoors. Let us further assume that *Chemical Engineering* has published the pertinent cost correlation diagrams which show (*a*) Cost per Ton vs. Annual Consumption, and (*b*) Cost per Ton vs. Storage Capacity. In a moment the estimator has a reliable figure useful for design work and budget purposes, without having had to consider any of the innumerable details of the problem; that is, at this time he is not concerned as to the method of handling, whether it is by means of a dragline, conveyor belt, gantry-crane, or otherwise. These details will be determined later when the project is in the final design stage. Data from other sources will determine this, and this will not necessarily require a change in the original cost estimate.

The establishment of practical cost standards appears to be a most worthwhile objective for the process industries. The problem, however, is to secure the necessary data. If they could get together in some suitable way the readers of *Chemical Engineering* could be a source for such data. An ideal field in which to test methods for compiling cost in this way lies in *Operation Costs* in the process industries. The writer (and the editors.—Ed.) would be interested in comments and suggestions from readers on this proposal. If the response should confirm the conviction that such proposal is worthwhile, some practical way to accomplish these aims should be possible.

A mountain of data is scattered over the entire field of chemical engineering. If Mahomet cannot go to the mountain, very well: Let the mountain come to Mahomet!

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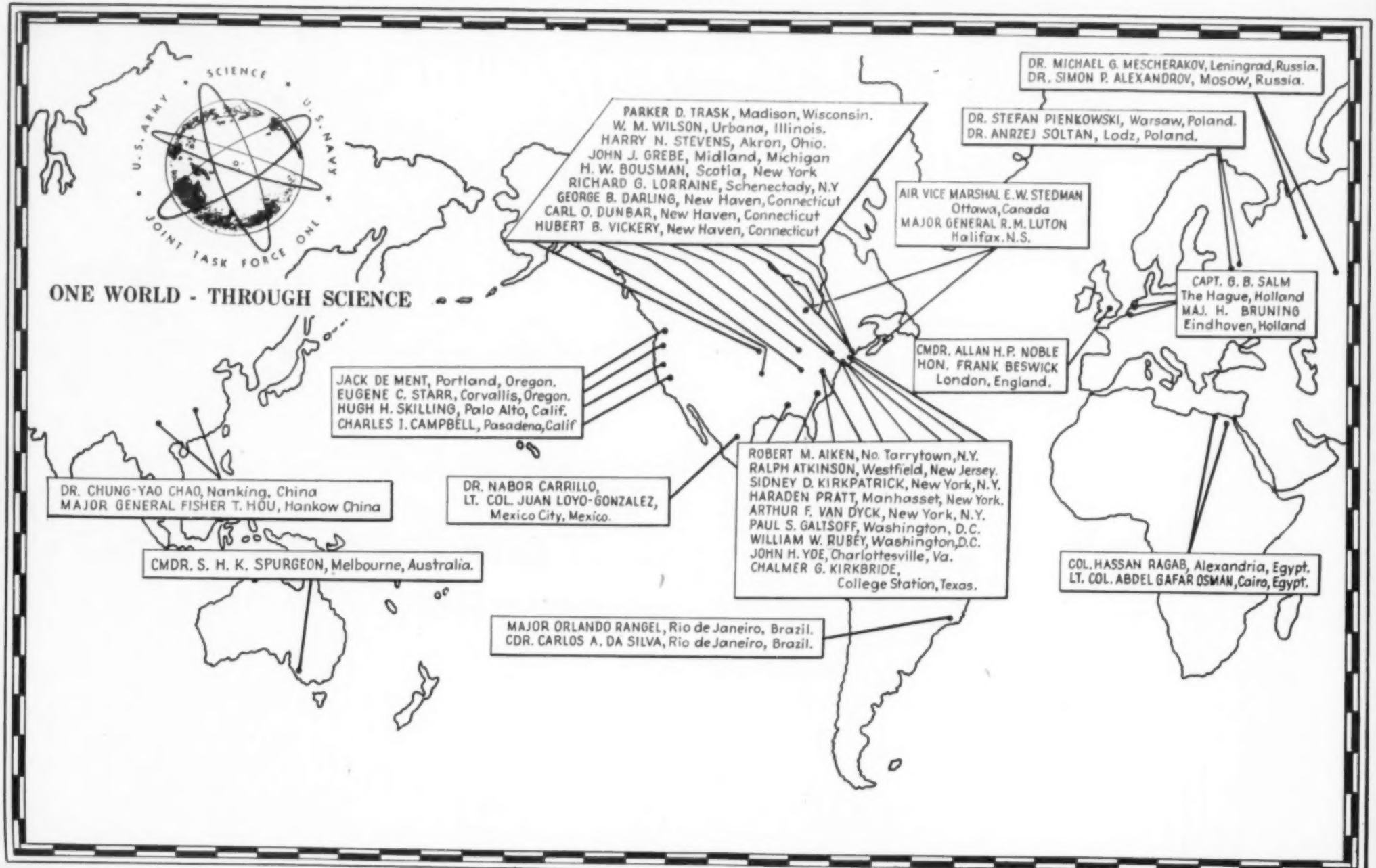
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INTERNATIONAL OBSERVATIONS
On Operation Crossroads

ATOMIC fission is itself a great international achievement, and there is no denying the fact that it has had and will long continue to have political repercussions. It resulted from cooperation, collaboration and competition among the scientists of many nations. Before trying to develop some of these aspects in more orderly fashion, the author desires to sketch briefly the background of his own observations as based on the nature of his association with Operation Crossroads.

For exactly two months (June 12 to Aug. 12, 1946) I lived on the USS Panamint (AGC-13) in intimate association with two important groups—the official delegates from the United Nations, and the U. S. non-participating scientific observers. The U. N. delegation consisted of 21 men, representing 11 foreign powers: Australia, Brazil, Canada, China, Egypt, England, France, Mexico, Netherlands, Poland and Russia. It was made up of both military and civilian observers, most of the latter being scientists. England sent two recently elected members of her Parliament—one Conservative and one Labor Party representative. France and the Netherlands sent naval captains and physicists in their military-civilian teams. Mexico was represented by a research professor of engineering and a lieutenant-colonel of ordnance; Canada by an air vice marshal and a major general; China by a major general (formerly lieutenant-general) and a professor of physics at the University of Nanking; Poland by two physicists—the president of the University of Warsaw and a professor at Lodz University; Russia by a professor of mineralogy and ore dressing, and by the young physicist who heads the cyclotron laboratory in Leningrad. These were men of real distinction and knowledge as they proved over and over again in our many conferences.

The U. S. delegation consisted largely of technical representatives from American industries and universities. There were also 21 of us. Twelve were engineers (five electrical, three radio and electronic, three chemical and one civil or structural). There were four chemists, three geologists, one biologist, and one public health specialist. We included representatives of such com-

United Nations Delegation and U. S. Non-Participating Scientific Observers, Operation Crossroads

ABOVE—*Top Row:* Dr. Bertrand Goldschmidt, Curie Laboratories, Paris, France; Major H. Bruining, Physicist, Philips Laboratories, Eindhoven, Holland; Air Vice Marshal (retired) E. W. Stedman, Royal Canadian Air Force; Maj.-Gen. (retired) R. M. Luton, director Medical Services, Canadian Armies Overseas (1939-46); Dr. Nabor Carrillo, director of scientific research, National University of Mexico. *Middle Row:* Dr. Simon P. Alexandrov, professor of ore dressing, Institute of Non-Ferrous Metals and Gold, Moscow; Cmdr. Carlos A. Da Silva, naval architect, Royal Brazilian Navy; Dr. Stefan Pienkowski, president and professor of physics, Warsaw University, Warsaw, Poland; Capt. G. B. Salm, Royal Netherlands Navy; Cmdr. Allan H. P. Noble, member of British Parliament; Dr. Anrzej Soltan, professor of physics, Lodz University, Lodz, Poland; Dr. M. G. Mescheryakov, director of cyclotron laboratories, State Radium Institute, Leningrad; Cmdr. S. H. K. Spurgeon, Royal Australian Navy; Capt. Henri Ballande, General Staff French Navy. *Bottom Row:* Dr. Chung-Yao Chao, director, department of physics, National Central University, Nanking, China; Lt.-Col. Juan Loyo-Gonzalez, ordnance officer, Mexican General Staff; Lt.-Col. Abdel G. Osman, chief inspector of explosives, Egyptian Army; Major Orlando Rangel, chemical engineer and adviser to Brazilian representative on the United Nations Atomic Energy Commission; Col. Hassan Ragab, military attache and adviser to Egyptian representative on United Nations Atomic Energy Commission.

BELOW—*Top Row:* S. D. Kirkpatrick, McGraw-Hill Publishing Co.; H. W. Bousman, General Electric Co.; W. W. Rubey, U. S. Geological Survey; W. M. Wilson, University of Illinois; Ralph Atkinson, General Cable Corp. *Middle Row:* Eugene C. Starr, Oregon State University; Robert M. Akin, Hudson Wire Co.; Paul S. Galtsoff, Senior Biologist, Fish and Wild Life Service, Department of Interior; Parker D. Trask, University of Wisconsin; John J. Grebe, Dow Chemical Co.; Hugh H. Skilling, Stanford University; Harry N. Stevens, B. F. Goodrich Co. *Bottom Row:* Arthur F. Van Dyck, R.C.A. Laboratories; Carl O. Dunbar, Geologist and Director, Peabody Museum of National History, Yale University; Richard G. Lorraine, General Electric Co.; Jack De Ment, Fluorescence Laboratories; H. B. Vickery, Connecticut Agricultural Experimental Station; John Howe Yoe, University of Virginia.

Missing: Hon. Frank Beswick, Member of British Parliament; Maj.-Gen. Fisher T. Hou, Chinese Military Attache and Member of Military Staff Committee, United Nations; George B. Darling, Yale University, and C. G. Kirkbride, Texas Agricultural and Mechanical College.

panies as General Electric (2), Radio Corporation of America, Dow Chemical Co., B. F. Goodrich Co., General Cable Co., Hudson Wire Co. and McGraw-Hill. There were two men from the faculty at Yale, and one each from Stanford, Virginia, Wisconsin, Illinois, Oregon State and Texas A. & M. We worked, lived and played together. There were formal meetings and discussions almost every afternoon and they often lasted for several hours.

As pointed out in one of these sessions by Dr. Goldschmidt, the brilliant young physicist from the Curie Laboratories in Paris and a member of the French Atomic Energy Committee, the A-bomb was truly the product of international scientific competition and collaboration which started 50 years ago in France. In 1896 Marie Skolodowski, a young Polish scientist, went to Prof. Henri Becquerel in Paris and asked for a subject she could study for her doctorate. He invited her to investigate certain uranium compounds that gave off peculiar radiation he called "uranic" rays, but which we now know were the alpha particles of radioactive radiation. She soon discovered that their intensity was not directly proportional to the uranium content of the various ores and compounds and she surmised that they might be caused by minute quantities of certain other elements or impurities. She went to her friend, the eminent French physicist, Pierre Curie, to ask his help with her problem. He thought that together they could clear the whole thing up in a couple of weeks, yet we know it became their life work and that of their daughter, Irene, and son-in-law, Joliot.

FRANCO-GERMAN COMPETITION

The Curie's ultimately discovered that the rays were related to the presence of two new elements, polonium (named after Marie's native Poland), and radium, which has meant so much to the human race. Workers in the Cavendish laboratories in England soon proved that the rays were alpha particles—actually helium atoms formed by the disintegration of uranium. This, in effect, made a reality of the Philosopher's Stone of the ancient alchemists, for if elements disintegrated to form others, it should ultimately be possible to transmute one to another. In feverish haste many groups of scientists in various parts of the world began using these alpha rays in an attempt to produce new elements or to make radioactive isotopes of existing elements. Later new types of atomic bombardment were tried, some using as "bullets," the neutrons that had been discovered by Chadwick in England in 1932. A group of German chemists and physicists soon claimed to have discovered seventeen new elements and proceeded to name and number them in their places in the periodic table. But the Curies' were sure that the Germans had used faulty techniques and that their so-called new elements were really isotopes of the elements with which they were working. They did some work to prove their case and wrote a scientific paper on the subject.

When Dr. Hahn, in Germany, got a copy he said "The woman's crazy! Now I will have to waste six months in proving she is wrong." Instead he worked several years at it and finally came out with a paper in which he admitted that his earlier work was in error—that most of the so-called new elements were really isotopes of barium. Why barium? Leitz Meitner, who had been working with Hahn and Strassman in Germany, but was now a voluntary exile in Sweden, made the suggestion that the big clumsy uranium atom had actually been split in two, and that barium was but one of the pieces. She and her brother-in-law, with whom she had been working, calculated on purely theoretical grounds that the products of such a fission of a single atom of uranium should repel each other to the extent that they would release about 200 million electron volts of energy. She communicated that information to the great Danish physicist, Niels Bohr, then in the United States. He in turn discussed it with Professor Einstein of Princeton, Fermi and Dunning of Columbia, an' others who immediately set to work to prove or disprove the theory. In a matter of weeks atomic energy was being released in at least five laboratories throughout the world.

Professor Alexandrov, the able and courteous Russian mineralogist, injected into our discussions the question of uranium ore supplies. One obtained the impression that throughout many parts of the world there is real envy of the United States and of our stock of ores and fissionable materials. Professor Alexandrov talked to us long and interestingly about the resources of the USSR, outlining plans for how Russia's uranium ores will be exploited as raw material for atomic energy.

As far as the U. S. scientists (and none of us like to be called that!) were concerned, most of our discussions had to do with (1) the bomb as a military weapon, (2) its effect on materiel and personnel, and (3) its possible peacetime uses as atomic energy. Our geologists proved pretty conclusively that the bomb had little or no seismic significance as a producer of earthquakes. The civil engineer thought he saw uses for it in helping to make over the face of the world, and we discussed the possible use of the A-bomb as a super explosive. The electrical engineers wanted to see atomic energy harnessed directly by more efficient means than through a steam or heat cycle. The chemists and chemical engineers were concerned with the effects of atomic heat and blast on the constitution of matter, on temperature-pressure relationships that might be employed in the synthesis of new alloys—even new elements. The biologists were most interested in the effects of radioactivity on the flora and fauna of the islands, on fish and wild-life. Being primarily scientists, all of these men were hesitant to draw too many conclusions or to talk too much until they had the necessary facts and figures. In the case of Operation Crossroads, we all realized that the data collected in the vast system of instrumentation belonged first of all to the armed services and only secondarily to the non-participating scientists.

This does not mean that these subjects were not discussed in never-ending detail by both groups. But it does mean that that few conclusions were reached, and often they must remain speculative until all of the data are assembled and made available—subjects which we hope will be discussed in scientific and technical articles for years to come.

THE RACE IS ON!

Of this much we are certain. An atomic armament race is already under way and gaining momentum every day. It's too late now to think that we can stem that tide by merely commanding the waves to stand still. Atomic energy is with us to stay and cannot be outlawed by any international edict unless it is enforced by public opinion, backed by proper authority. The world does not want to go through the travesty of another Harding Disarmament Conference in order to draw up another "piece of paper," such as the Kellogg-Briand treaty. We must face the facts realistically. It is our opportunity and obligation to see that atomic energy and its related scientific achievements are put to constructive use, but we would be foolish indeed if we overlooked the destructive potentialities of the present bomb or what improvements will undoubtedly come from it. We must know how to use it if necessary in our national defense, and we must not neglect the study of every possible means of defending ourselves against its use by anyone else.

But I am convinced that there is hope that the enlightened nations of the world can and will work together, and that eventually we will develop the understanding, friendship and mutual respect that are the only bases for a lasting and enduring peace. We on the Panamint felt that in a very small way we demonstrated that "One World Through Science" is possible and practical, when people of the same ideas and ideals meet on common ground, to advance a common cause.

Editor's note: Excerpts from Mr. Kirkpatrick's personal diary of the two months he spent with Operation Crossroads have been published in the August *Chemical Engineering*, pp. 94-6. If judged of sufficient interest, the remainder will be mimeographed and made available at nominal cost to all who desire copies. Address inquiries to Editor, *Atomic Engineering*, Room 2400, McGraw-Hill Bldg., 330 West 42nd St., New York 18, N. Y.

EDWARD LEDOUX *Attapulgus Clay Co., Philadelphia, Pa.*

Continuous Drying of Adsorbent Materials

In view of its practical significance in the design of industrial dryers, the article of Mr. Ledoux will be of interest, particularly to those concerned with adiabatic drying. It presents a new method permitting the necessary determination of the countercurrent adiabatic humidification line for drying calculations.—*Editors*

Although the case of adsorbed water is to be considered in the following discussion, the general drying characteristics and the method of calculation remain similar in the more general case of sorbed water.

Elimination of adsorbed water can be effected by two different methods—intermittent and continuous.

The first method consists in charging the dryer with a certain amount of material to be processed and removing it once it is dried, subsequently recharging with a fresh batch of damp material. This operation is one of unsteady state.

CONTINUOUS DRYING

In the second method, which is much more economical in operating cost, the damp material is continuously introduced at one end of the dryer and it emerges continuously, at the desired water content, at the other end. Operation is continuous and the material is in permanent motion at uniform speed. The process air is introduced at the material outlet and emerges at the material inlet end; material and air therefore circulate in counterflow. The air in driest and hottest condition enters into contact with the material in its driest state; its humidity increases and its temperature decreases as it proceeds through the dryer due to the fact that the material encountered is damper and damper. The operation is one of steady state.

The purpose of calculation is to determine the length of dryer required to reduce down to a final concentration c_0 a flow of B lb. per hr. of material having an initial concentration c_1 by means of a flow of A lb. per hr. of dry air having an absolute humidity w_0 at inlet.

Let us first consider the case of isothermal operation.[1] This is the simplest because the humidification line on the psychrometric chart is the line of constant temperature considered, while the curve giving the equilibrium humidity of the material as a function of its concentration is its isotherm. Fig. 1 is a plot of this isotherm, care being taken to use the same units for concentration as for absolute humidity, that is to say pounds per pound.

At any point in the dryer, the increase in humidity of the air is equal to the decrease in concentration of the material; therefore,

$$A\,dw = B\,dc$$

Note that the equation has no minus sign because, due to countercurrent flow, dw and dc have the same sign when moving from one end of the dryer to the other.

Integration between any section of the dryer and the air inlet end (material outlet) yields the equation of a straight line

$$A\,(w - w_0) = B\,(c - c_0)$$

For all points in the dryer, the humidity of the air must satisfy this equation which is that of the locus of the air humidity as a function of the concentration of the material at the same point. Let us plot, on Fig. 1, this line whose slope is B/A and whose initial point w_0, c_0 is known. Its intersection with the vertical c_1 gives the absolute humidity of the air at its outlet (material inlet) and the intersection of the vertical c_1 with the isotherm gives the equilibrium absolute humidity of the material as it is introduced; the intersection of the vertical c_0 with the isotherm gives the equilibrium absolute humidity of the material as it emerges.

IN THE DRYER

At any point in the dryer, the variation in concentration of the material is equal to the evaporation, or:

$$B\,dc = K(w' - w)\,S\,dl$$

In this equation, S is the cross section of the dryer in square feet and K is the coefficient of vapor transfer per cubic foot of material.

The coefficient of vapor transfer is a function of concentration. This is due to the fact that the vapor must diffuse inside the material before it can be taken up by the air at the outer face of the particles. The resistance to diffusion increases as the concentration becomes lower so that K decreases at the same time as the concentration. This function is a characteristic of the material which can be determined experimentally by a batch method analogous to that for the coefficient of heat transfer. It can also be determined by plotting, experimentally, w as a function of l in a continuous dryer. Indeed, from the above equation, the expression of K is

$$K = (B\,dc/dl)/S(w' - w)$$

while Fig. 1 gives the values of c for any value of w. Therefore, if w is known as a function of l, the curve c vs. l can be plotted and its slope dc/dl measured. Then, dc/dl is known as a function of c while $(w' - w)$ as a function of c is given by Fig. 1. Consequently, K can be plotted as a function of c by means of its expression given above.

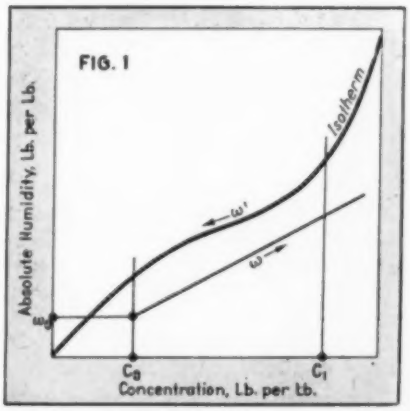

Fig. 1—Equilibrium humidity as a function of material concentration

Integration of the transfer equation yields the length of the dryer.

$$l = \frac{B}{S}\int_{c_0}^{c_1} \frac{dc}{K(\omega' - \omega)}$$

Since we do not know the analytical relation linking K and $(w' - w)$ to concentration, it is not possible to integrate directly. However, K being a characteristic of the material, its values for different values of c are known and the values of $(w' - w)$ as function of c is given by the difference in ordinates between the isotherm and the straight line on Fig. 1. It is therefore possible to plot the curve $1/K(w' - w)$ vs. c and the area, limited by this curve and the abscissa axis between the limits c_0 and c, multiplied by B/S, is equal to the distance from the material outlet at which the concentration is c. The total length of the dryer is equal to the surface between c_0 and c_1. With the

units adopted here, this length is expressed in feet but the calculations can of course be carried out in any consistent system of units.

Note that, since the coefficient of transfer is a function of the relative velocity between air and material, it is function of the dryer cross section. Therefore K and S are not independent—the choice of one determines the other.

Note also that, the finer the particles of material, the shorter the dryer since K is proportionate to the surface of contact per cubic foot of material.

The drying time θ is proportionate to the length of the dryer since, if V is the velocity of the travel of the material, $l = V\theta$.

For drying of the material to occur, it is obvious that at all points in the dryer the humidity of the air must be lower than the equilibrium humidity of the material $(w' - w) > 0$; the straight line representing the humidity of the air must therefore always be below the isotherm. If, for the same flow of material, the air flow is decreased, the slope of the line increases, $(w' - w)$ decreases, the surface to be integrated increases and the result is an increase in length of dryer required. If the air flow is reduced to the extent that the line becomes tangent to the isotherm, the length of dryer becomes infinite since, at the point of contact, $w' - w = 0$. The slope of the tangent therefore determines the theoretical minimum air flow for a given final concentration c_0 and the air humidity w_0. In practice, the flow must be sufficiently greater than the theoretical minimum for the length of dryer to be reasonable.

If the material is liquid (it is then not an absorbent) it is possible to approach isothermal operating conditions by means of heating elements placed inside the dryer. In the case of solid materials, this is not possible and the heating of the material is due entirely to the cooling of the air; operation is adiabatic or semi-adiabatic depending upon insulation and the initial temperature of the material.

For adiabatic conditions it is first necessary to plot, on a psychrometric chart featuring total heat[3] and upon which are shown the isosteres of the material, the adiabatic humidification line whose origin is of course at point 0 representing the conditions of the air at inlet (Fig. 2).

If no outside heat is supplied, at any point in the dryer

$$-A\,dQ = AL_x dw - B\,q\,dt' \qquad (dt' < 0)$$

This equation, in which q is the heat capacity of the damp material and t' its temperature, is that of the adiabatic humidification line. The relation indicates that, through its decrease in total heat dQ, the air supplies the net heat of desorption and the heating of the material. Net heat of desorption, L_x, is the difference between the heat actually required to vaporize the unit weight of an adsorbed liquid and the normal heat of vaporization at the same temperature.[2] The net heat is a function of concentration and also, strictly speaking, of temperature. In the temperature ranges encountered in drying, however, variations with temperature can be neglected.

Since $A\,dw = B\,dc$, the above equation may be written

$$dQ/dw = -(L_x - q\,dt'/dc)$$

The minus sign is due to the fact that Q decreases when w increases; t' decreases however when c increases so that dt'/dc is negative. Considering that dQ/dw is the slope of the tangent to the adiabatic humidification line, the problem consists in plotting a curve whose tangent is known. We know the value of L_x as a function of concentration at the average temperature since this is a characteristic of the material. However we do not know the value of dt'/dc as a function of c because the temperature of the material depends upon the humidification line itself. It is therefore necessary to proceed by successive approximations.

As a first approximation, the temperature variation of the material is neglected. Slope of the line then becomes $dQ/dw = L_x$ which is known for each intersection of the curve with the isosteres.

The slope at point O is equal to the net heat L_x for the concentration 1 percent (Fig. 2). Let us now cross-hatch each isostere with parallel lines whose slope equals the net heat for the corresponding concentration; the lines do not necessarily have to be equidistant. This being done, it is possible to run the humidification line through the groups of cross-hatching. The precision increases with the number of isosteres available; it can also be increased (although this is not necessary for the first approximation) by following up with the Picard process.[4]

For a given concentration, the temperature of the material is read at the intersection of the isostere considered and the adiabatic humidification line. It is therefore now possible to determine a first approximation of dt'/dc for each value of concentration. For instance, at point B where the concentration is 8 percent, we have

$$dt'/dc = (85 - 116)/(17 - 3) = -2.21$$

In practice, a larger number of isosteres should be available so as to permit taking a much smaller interval.

With this first approximation of dt'/dc, a second approximation of the humidification curve can be plotted by the method previously outlined, using the complete expression of dQ/dw. The accuracy of this second curve is usually sufficient for all practical purposes. Note that q is also a function of concentration since, if we call q' the specific heat of the dry material, $q = q' + c$.

The equilibrium absolute humidity of the water being vaporized (w') is given by the intersection of the adiabatic humidification line and the vertical lines of constant absolute humidity on the chart. We can thus plot the curve c vs. w' and apply the same method as previously for the determination of the length of the dryer, the newly determined curve c vs. w' being used instead of the isotherm.

For the drying to be adiabatic, the material must be introduced at the temperature indicated by the intersection of the isostere corresponding to the initial concentration and the adiabatic humidification line. For instance, in the case of Fig. 2, if the concentration of the material to be dried is 0.29 lb. per lb. (29 percent), the material must be introduced at 71-72 deg. F. Conversely, if it is the temperature of the material which is set, then the inlet air conditions are determined by the adiabatic humidification line which can be plotted from either end, whichever point is known.

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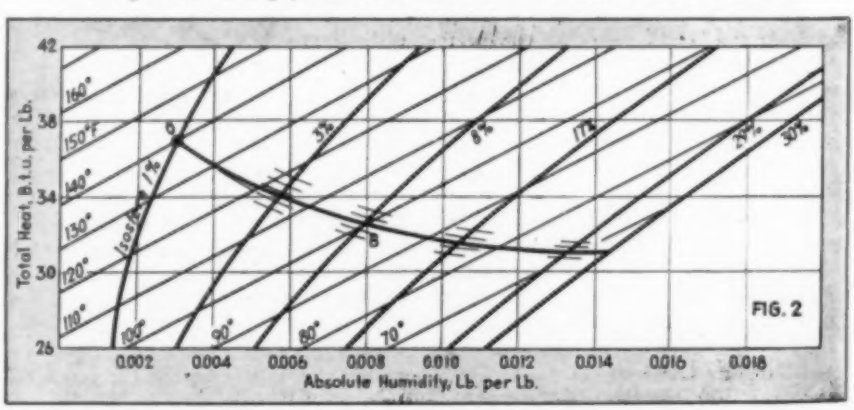
Fig. 2—Adiabatic humidification line with origin at inlet air conditions plotted on a psychrometric chart with isosteres of the material



Shipping Liquid Sulphur Is Practical

Test shipment of liquid sulphur in ordinary tank cars such as are conventionally used for hot asphalt have proved surprisingly successful. Transporting sulphur in this state rather than in the solid offers certain advantages to the consumer—one of which is that it is ready for use, an important point in modern contact acid plants. Engineers engaged in designing new sulphur burning plants or who are revamping present equipment, may wish to examine the benefits derived from receiving liquid sulphur in tank cars.—*Editors*

SHIPPING sulphur as a liquid instead of as a solid has intrigued engineers for a number of years. Recently the idea was put to test. It was demonstrated that sulphur can be shipped in the liquid or molten state and that under certain conditions handling sulphur in this way has several advantages.

Prior to the war sulphur was ordinarily shipped in box cars, barges or steamships. Because it was protected and covered during transit it arrived at the customer's plant in a clean condition. During the war years, however, due to the shortage of box cars, considerable quantities of sulphur were shipped in open top cars. Such shipments being exposed to the weather while in transit, often arrived at the customer's plant contaminated with cinders from coal-burning locomotives or containing extraneous materials picked up en route. If stored in the open it was further contaminated by dust and dirt from the plant grounds.

These contaminating materials often caused difficulties in the customer's equipment, particularly when the sulphur was burned in the newer types of sulphur burners in which molten sulphur is sprayed into a combustion chamber through atomizing nozzles. Cinders and other carbonaceous material were particularly troublesome as these reacted with the sulphur to form asphaltic compounds which clogged the atomizing nozzles and also interfered in other ways with the smooth burning of sulphur.

Engineers of the Texas Gulf Sulphur Co. discussed these problems with the operating staff of one or two consumers of sulphur and as a result a remedy was suggested; namely, the shipment of molten sulphur in tank cars. It was anticipated that sulphur so shipped would arrive in the same purity in which it flows from the wells at the company's mines. Experimental shipments of molten sulphur in tank cars were made.

Tests proved surprisingly successful. It was demonstrated that liquid or molten sulphur could be shipped in ordinary tank cars of 8,000 to 10,000 gal. capacity such as are conventionally used in the shipment of hot asphalt. The cars used were lagged with only about two inches of insulation. But even with this equipment which was not especially insulated, it was possible to ship the sulphur distances involving transit time of ten days or more and have it arrive in a comparatively fluid condition. Since the cars used were provided with steam heating coils it was a simple matter to remelt the solidified sulphur and to drain or pump it to holding tanks or pits.

It is anticipated that in the future, should the transportation of liquid sulphur become a common practice, that special tank cars properly insulated will be built so that the solidification of sulphur during transit will be considerably reduced. It was particularly interesting to note that even if delays in transit occurred, and even if the sulphur in the car should solidify completely, it was possible to remelt it without damage to the interior steam coils or to the tank car itself.

CERTAIN ADVANTAGES

Shipping molten sulphur in tank cars offers certain advantages to the consumer. The product as received is as pure and uncontaminated as when it leaves the mines. It is free of dirt, and ash is a minimum. Since it is not exposed to the weather it is dry and therefore free of sulphuric acid. This means that corrosion of sulphur handling equipment in the plant is decreased. Unloading solid crude run-of-mine sulphur is a dusty operation and often during unloading operations, particularly during a high wind, excessive losses of sulphur may occur. Liquid sulphur from tank cars may be unloaded by gravity or by pumps; it is a dustless operation, a fact greatly appreciated by labor, and sulphur losses during transfer are negligible. Furthermore, the sulphur is ready for use, an important point in modern contact acid plants, where all sulphur usually is melted prior to burning and, hence, the receipt of molten sulphur means a saving in steam.

AN INNOVATION

Shipping liquid sulphur is an innovation not only for the sulphur consumer, but also for the producers of sulphur, and many factors in connection with its shipment still remain to be solved. The sulphur producing industry has designed all of its handling and storage equipment to handle only the crushed solid. Handling sulphur in this manner enables the industry economically to maintain the large stocks of sulphur, and guarantee to its consumers ample stocks of this essential element. Should the sulphur industry find it necessary to ship a great portion of its production as liquid sulphur, its entire storage and handling facilities will need to be revised.

STOCKPILES

It is doubtful whether the industry under such conditions would be able to maintain the same large stockpiles. The customer is also confronted with the question of stockpiles and it is anticipated he also will want to maintain fairly large reserves of sulphur of the crushed solid to take care of unanticipated demands, as this is the easiest way in which the material can be stored. It, therefore, is doubtful whether the shipment of molten sulphur will become a universal practice. But for those customers who are located so that regular shipments of molten sulphur can be made to take care of their demands, liquid sulphur in tank cars offers certain definite advantages.

The success attending the shipment of molten sulphur in tank cars has also led to suggestions regarding shipment of liquid sulphur in barges and steamships. Since molasses, heavy crude oil and asphalt are being handled in this manner, this suggestion is but natural. However, it would appear that shipment to consumers in molten state will be confined to tank car lots direct by rail to point of consumption. Engineers engaged in designing new sulphur burning plants or who are revamping present equipment, may wish to examine the benefits that can be derived from receiving liquid sulphur in tank cars.

POTASH INDUSTRY

Resources, Operations and Prospects

American potash interests recently issued three reports regarding its industry on "Potash Reserves of the United States" by Samuel H. Dolbear; "The Economics of the Potash Industry" by Jules Backman; "Past Consumption and Future (1950) Requirements of Potash Salts in American Agriculture" by J. W. Turrentine. This article summarizes outstanding factual and opinion summaries from these reports in an effort to present a broad picture of the industry as a whole. Substantially all of the text represents verbatim quotation. but no effort is made to separate the items according to original authorship.—*Editors*

POTASH-BEARING materials from which production is now obtained and those which comprise possible sources may be classified as follows:

Highly water-soluble minerals, either in the form of brines; or as solid deposits in which the potash occurs principally as sylvite carnallite and langbeinite.

Polyhalite—a compound of potassium sulphate with other sulphates—which though water-soluble is less so than those mentioned above.

Potash-bearing silicates such as greensands and certain shales in which the potash-containing constituent is insoluble but from which water-soluble potash can be produced by appropriate chemical treatment.

Sundry materials such as portland cement and iron blast furnace flue dust from which potash can be recovered as a byproduct.

Miscellaneous materials that will yield potash, the most plentiful of which is sea water.

The terms "economic mineral reserves" or "ore reserves" are customarily used to designate minerals which can be mined and marketed at a profit. Such a profit must be continuously available, otherwise reserves may be created or obliterated by the economic tide. Increases in cost or decreases in selling price may wipe out economic reserves and conversely decreases in cost or higher selling prices may create reserves, while in fact there has been no change in quantity or richness of the deposite themselves.

In this (Dolbear) report we are concerned not only with "economic reserves" but also with what has come to be known as "strategic reserves." While the cost of production cannot be entirely disregarded in "strategic" material, its production under emergency conditions does not necessarily involve the element of profit. The term "strategic reserves" as used herein includes therefore any potash-bearing material that may in the future be made to yield potash with a reasonable expenditure of labor and material.

RESERVES ESTIMATED

Known resources of potash in brines and in highly soluble salts of deposits now under production amount to 107 million tons of actual potash (K_2O) of which 73 million tons are estimated to be recoverable. Possible reserves of sylvite yet undeveloped in the New Mexico field may add as much as 400 million tons to these reserves.

Proved reserves of polyhalite are estimated at 140 million tons of K_2O and there is in addition over 100 million tons of K_2O in probable reserves, with possible reserves several times these figures.

Potash-bearing silicate rocks are available in almost inexhaustible quantities. While the cost of extracting potash from such materials would be greater than in the case of soluble potash minerals, they constitute nevertheless sources of potash which could be used in an emergency.

Both known reserves and potential sources of potash in the United States are so extensive that any apprehension as to early exhaustion is unwarranted. Reserves other than those now under production, including partly developed sources and "strategic reserves" which may be utilized in an emergency, provide a tonnage so large that exhaustion is not predictable within several hundred years.

Gross reserves of potash (K_2O) in solution (brines) and present as highly soluble salts are as follows, the figures representing tons: New Mexico, 85,963,000; California, 20,000,000; Utah (brines-recoverable), 1,000,000—or a total of 106,963,000.

Recoverable reserves of potash from the above are: New Mexico, 58,000,000; California, 14,000,000; Utah, 1,000,000—a total of 73,000,000. This represents an overall average extraction of 68.2 percent.

At the assumed rate of consumption of 500,000 tons annually and with no imports of foreign potash, these already developed and producing sources are sufficient for 146 years. If it is assumed that imports will again be on a prewar scale, then these reserves would last for over 290 years. (These data seem low, as present annual consumption in U. S. is 750,000 tons.—Editor.)

Possible additional undeveloped reserves in the New Mexico area may amount to more than 400 million tons, and if this is realized by future exploration, such reserves, together with the presently developed tonnage, would last at the rate stated for over 685 years.

Strategic reserves are regarded as those which may be drawn upon in case of emergency. They include, therefore, not only potash materials which may be produced commercially, but those which may be utilized with a reasonable expenditure of labor and materials in an emergency. For the purpose of this report, however, they have been limited to potash-bearing materials under production in 1945, plus those covered by reports of the U. S. Bureau of Mines and others, and indicated as having possible commercial character.

To this must be added possible recovery of byproduct potash with a potential annual production in tons as follows: portland cement, 100,000; blast furnace, 200,000; distillery waste, 140,000; or a potential total of 440,000.

INSOLUBLE POTASH

Greensands, also called marls, are widely distributed in the United States, and are particularly conspicuous on the eastern seaboard. While the potash content is much lower than that of the sylvite deposits of New Mexico, and problems of treatment are more difficult, the huge tonnage and its nearness to the principal consuming areas make greensands one of the largest potential sources of potash in the United States.

Commercial exploitation of these deposits may require the utilization of large tonnages of waste material in the manufacture of portland cement, sand-lime brick, activated silica, or other byproducts. While greensands need not be utilized as a source of potash so long as high grade soluble salts are available elsewhere, they serve as a large reserve located close to points of consumption of both potash and the byproducts which might be derived from its production.

Georgia shales, sometimes referred to as the Cartersville slate, extend from Cartersville, Ga., northwestward, a distance of 9 miles. They are found over an area several miles in width, with a depth of thousands of feet. As in the case of greensands, utilization of this material probably involves the production of portland cement or the provision of some other outlet for large quantities of waste material. Also, as in the case of greensands, these deposits are close to the principal areas of consumption of potash and other byproducts.

Wyomingite deposits are not advantageously situated with respect to markets for its products. Plans are, however, being made by a large chemical company to produce potassium carbonate from wyomingite as an incident to the operation of Wyoming trona (soda) deposits. Potash in this form is used entirely in industry and commands a higher price than fertilizer potash.

POTASH FROM CEMENT

Raw materials entering into the manufacture of portland cement contain small percentages of potash, the potash being volatilized and passing out of the cement kilns with dust and furnace gasses. There are 113 cement plants in the United States, the raw materials of which contain from 0.20 percent to 1.16 percent of potash of which 24.5 percent to 95.9 percent is volatilized.

Thus the amount of potash escaping in stack discharge amounts to 0.35 to 5.15 lb. per bbl. of cement, with an average of 1.93 lb. per bbl. Based on the five-year period average (1935-39), average annual production of 106,636,443 bbl., equal to 20,047,651 short tons, but omitting stack discharges amounting to less than 1 lb. per bbl. of cement produced, there is recoverable about 84,000 tons of potash annually from cement plants. Certain changes in practice could increase this amount to in excess of 100,000 tons of potash per year.

In recent years only one cement plant, located in Maryland, has recovered and marketed this byproduct potash.

POTASH FROM FURNACE DUST

Blast furnace charges, comprising iron ore, coke and limestone, contain minor amounts of potash which are volatilized and may be recovered by treatment similar to that applied to Portland cement dust.

According to Merz and Ross for each ton of pig iron produced, 4.9 lb. of potash (K_2O) are volatilized, representing 84,000 tons per year on a basis of 33,700,000 tons of pig iron.

According to Turrentine, the addition of a small amount of common salt to the charge more than doubles the yield which could, under American practice, be increased to 200,000 tons of K_2O per year. Wartime production of about 60 million tons of pig iron would, of course, increase this amount. No potash has been recovered from this source in recent years.

RESOURCE CONCLUSIONS

Developed potash reserves in mines now under operation comprise a small part of resources. They are, however of substantial size and constitute present sources of supply for agriculture and industry. That the tonnage in New Mexico will be substantially extended if exploratory work is undertaken, there can be little doubt. Potential additional potash ore in that area is possibly 400 million tons.

The beds of sylvite-carnallite ore in eastern Utah appear to be 10 to 20 times as thick as the sylvite beds in New Mexico. Their areal extent and grade remains to be established by further exploration, nevertheless they are regarded as of potential importance.

Salt beds of Texas are known to contain sylvite and other potash minerals, but these occurrences have not been adequately explored, hence estimates for this area are omitted.

Polyhalite is widely distributed through New Mexico and Texas, and established reserves in the Carlsbad area are extensive enough to supply U. S. demand for over 200 years.

Recoverable potash in soluble minerals and brines, reasonably established by existing exploration, constitute adequate reserves for the present and can be extended substantially by further exploration.

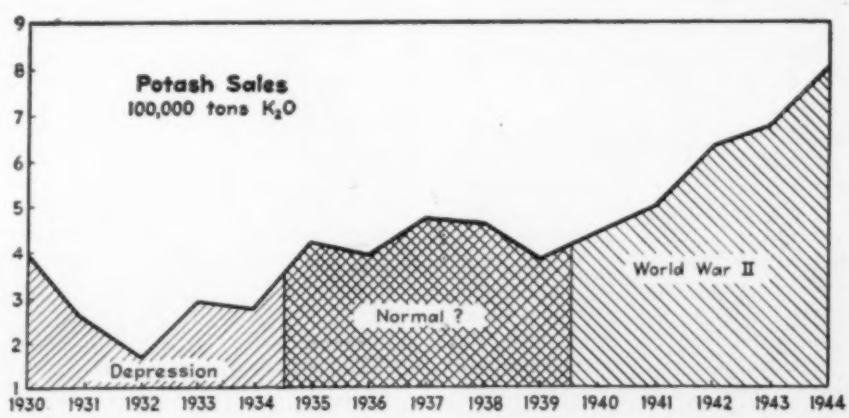
Potash in insoluble form in various rocks has been established to exceed 850 million tons. By suitable treatment this potash can be produced in water-soluble form. Developed and potential reserves of soluble potash are so extensive however, that there appears to be no justification for further attempts to utilize these insoluble materials at present. They comprise, however, a huge back-log of secondary character.

WARTIME POTASH

The wartime record of the potash industry is outstanding whether measured in terms of output, prices, or labor relations. The record of inadequate supplies and skyrocketing prices during World War I was replaced by a record of stable prices and a tremendous expansion of output during the recent conflict. The highlights of this present study, which examined the industry's long-term development as well as its wartime record, may be summarized as follows:

Supply of Potash—This is a small industry with relatively few producers. Annual sales at the wartime peak were about $30,000,000. Domestic production has been expanding steadily since 1921. Output expanded from 10,171 tons K_2O in that year to 312,000 tons K_2O in 1939 and 835,000 tons K_2O in 1944. Imports accounted for more than half the domestic consumption before the war cut them off. The production increase of 522,368 tons in 1944 as compared with 1939 more than offset by a wide margin the decline in imports. The potash industry's wartime expansion was financed privately.

Demand for Potash—Approximately 90 percent of the potash is used in agriculture; the remainder is used in chemical industries. Potash is used in each of the 48 states. However, almost two-fifths of the potash is delivered in five southeastern states: Georgia, Florida, Virginia, North Carolina, and South Carolina. Potash is used in connection with many crops. Potash content of mixed fertilizers has been steadily increased. From 1920 to 1943 plant-food content increased by 6.4 percentage points of which potash accounted for three-fourths. In 1920, about 17.3 percent of the plant-food content of mixed fertilizers was potash. In 1930, the proportion was 28 percent and in 1943 it was 35.6 percent for potash is not determined by its price because it represents



only a small proportion of the total cost of mixed fertilizer.

Prices—Potash is quoted on a K_2O basis thus making it possible for producers of all grades to compete directly in terms of price. Prices are quoted fob Carlsbad, N. M., and Trona, Calif., and ex-vessel at about 40 ports; the result is a multiple basing-point system of pricing. The customer is given the option of taking the shipments on the basis that will result in the lowest price to him. This fob system results from the adoption by the industry of recommendations made by U. S. Department of Commerce experts in 1940. To even out flow of deliveries, the industry uses a system of discounts recommended by the U. S. Department of Commerce. On orders placed prior to June 3, a 12 percent discount is granted, on orders placed from July 1 to September 30, the discount is 6 percent. Part of the discount is paid at the end of March upon completion of contracted deliveries. On shipments from Carlsbad, freight costs average about one-third of the cost to the consumer. This is due to the fact that the main consumers are in the East while potash is produced in the West. Potash prices showed practically no change during the war. This record is in sharp contrast with the 110 percent rise in farm prices. 35 percent increase in wholesale prices, and 21 percent increase in fertilizer prices. Price stability in World War II compares with an almost tenfold increase in World War I. Long-term trend of potash prices has been downward. Muriate of potash prices in 1944 were 27 percent below those in the period 1910-14.

Labor Relations and Wages—The industry has one of the most liberal labor records. In addition to high wages, workers received various benefits including: sick leave, retirement pensions, two-week vacation after two years, transportation allowance, provision of tools and equipment, holidays with pay, maintenance of membership, seniority, etc. During the war a liberal incentive wage bonus system was adopted in the Carlsbad area. Yearly average bonus payments ranged from 10 percent to 15.85 percent of earnings. Labor productivity appears to have increased by about 5 percent in the Carlsbad area during the war years as a result of the adoption of the incentive wage system.

Industry and Government—Industry and government agencies have cooperated in the exploration for potash resources. Potash companies mainly operate on government-owned lands under leases issued by the Department of the Interior and to a small extent by the states. Royalties are paid by the companies at rates specified in the leases. Despite the splendid wartime and prewar record, numerous proposals have been made to expand government control over the potash industry. Such proposals have been made by the National Farmers Union, Tennessee Valley Authority, American Farm Bureau Federation, a special committee of the U. S. Department of Agriculture and the U. S. Department of the Interior. Programs deemphasizing government control have been proposed by the National Council of Farm Cooperatives and the National Planning Association.

PROTECTING AMERICAN POTASH

Competition in potash from foreign countries is to be expected. American industry as a whole realizes the importance of international trade and that this must be based on exports as well as imports. The potash industry does not request any protective measures which are not warranted and which are not as a rule granted to industries in general.

Protection which the potash industry deserves may be summarized briefly: Since potash is a vital industry in war as well as in peace, it deserves protection from unwarranted competition from abroad. This is particularly so since there are no tariffs protecting the American producers of this commodity. As a result of the war, important changes have occurred in the potash industry outside of the United States. There is a possibility that production in countries in Europe will be government-owned-and-controlled and that it may be dumped in the United States to create dollar exchange. There is the danger that potash received in the form of reparations by some countries may be sold to the United States or that such receipts of potash will release domestic stocks for shipment to the United States. There is a possibility that a powerful new potash cartel may be formed which may adopt a price policy detrimental to American producers. American potash industry has a right to expect protection. The best method of achieving this would be the establishment of a quota system based on consumption in the United States.

POSTWAR POTASH NEEDS

On the basis of Department of Agriculture and Tariff Commission figures requirements of potash for 1950 are estimated to be: In agriculture—with full play of economic forces: (a) Full employment, 612,000 tons K_2O (b) some unemployment, 445,000 tons; in chemical industries—(a) Full employment, 50,000 tons K_2O (b) some unemployment, 40,000 tons (c) Depression—25,000 tons.

Proved and Strategic Potash Reserves of United States

	Gross Estimated Tons—K_2O
Sources in production, 1945	
Brines	21,000,000
Highly soluble salts	85,963,000
Total	106,963,000
Soluble—In operating mines but not in production, 1945	
Polyhalite	240,000,000
Glaserite-hanksite	11,200,000
Total	251,200,000
Insoluble	
Greensands	513,905,000
Georgia shales	250,000,000
Wyomingite	94,000,000
Total	857,905,000
Grand total	1,216,068,000

Postwar potash supplies for the United States would consist of domestic production, forecast at the potential rate of 875,000 tons of K_2O, and importations from Europe which have been estimated by Tariff Commission. Total supply, depending upon the degree of domestic business activity, would therefore, according to government estimates, amount potentially to: with full employment, 1,178,000 tons with some unemployment, 1,072,000 tons. Thus, the surplus of potential supply above requirements would be in excess of one-half million tons. Therefore, if there be imports of the order of magnitude predicted by the Tariff Commission, to avoid surpluses the domestic production would perforce be reduced to the levels of, with full employment, 359,000 tons K_2O; with some unemployment 288,000 tons K_2O.

ECONOMIC CONCLUSIONS

Within this (Turrentine) report there have been presented the estimates of postwar potash requirements and supplies recently released from federal sources. They must be accepted as impartial and informed. Wide discrepancies appear in these estimates, the result of varying suppositions and viewpoints based thereon. We have endeavored to compose these differences to produce a realistic presentation as a basis from which to proceed with a study of our postwar potash problem.

The following conclusions seem warranted:

Current rate of production of American potash mines and refineries will provide ample supplies for domestic use in 1950, even with the maintenance of a high level of national income.

Restoration of imports from Europe will contribute to a surplus which would appear to mean curtailment in domestic production, even to the point where, as indicated by certain estimates, the domestic industry is forced out of business.

The familiar expedient of disposing of surpluses by a price reduction would be of no avail in disposing of surplus potash since its wholesale price has no immediate and only an insignificant ultimate influence on retail, farm-delivered prices and therefore on consumption, the latter depending on farm income and that in turn depending on the over-all national state of employment.

With potash reserves of the dimensions disclosed in the Dolbear report, they will be ample for a minimum of 500 years at the rates of consumption projected by official forecasters and for such other longer terms of years as determined by the volume of future imports.

Napalm Reconverts From Incendiaries to Soap

GEORGE E. McCADDEN

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Honolulu, T.H.

During the war napalm was the thickening agent that turned ordinary gasoline into the sticky jelly used in fire bombs and flame throwers. Now, by the canny use of surplus materials, the Army converts it to a general purpose liquid soap.—*Editors*

NAPALM, which was belched in fiery arcs into Jap pillboxes, is being converted into soap by the army forces in the Middle Pacific Command. Already 10,000 gal. of the soap have been made and it is estimated that upwards of a million gallons could be produced from remaining stocks. It is somewhat germicidal and is being used in army hospitals and other installations in the Hawaiian Islands for washing dishes, pots and pans; to clean floors, woodwork, and porcelain; to wash cars, trucks, and aircraft; and as a liquid solvent in laundries.

Napalm contains the ingredients of soap and was, in fact, made by the nation's largest soap makers. It is a solid mixture of aluminum soaps, derived primarily from coconut fatty acids, naphthenic acids, and oleic acid. A satisfactory process for converting this into a soluble sodium soap was developed by Col. George F. Unmacht, Chief Chemical Officer of the Army Forces' Middle Pacific Command, and the staff of the 43d Chemical Laboratory Company.

First, prisoners mix the sweetish-smelling napalm with water and sulphuric acid in a lead-lined trough. From the resulting acid hydrolysis, the napalm yields its free fatty acids. Incidentally, this sulphuric acid, like everything else connected with the process, is a surplus item. By utilizing another surplus, silica gel, it is extracted in a simple contact process from FS, the smoke mixture formerly used to screen troops on beachhead operations.

After the Jap PW's, faceless and gnome-like in their gas masks, have stirred each fuming batch for an hour with garden hoes, the mixture is dropped into red cedar field laundry tubs, diluted with hot water, and bubbled with live steam for 1½ hr. Then it cools and stratifies. Water is drained off, removing aluminum sulphate and excess sulphuric acid, and the remaining free fatty acids are washed in hot water and pumped, still hot, to settling tanks made from gasoline drums.

After 10 to 15 hr. of draining, the batch is blown by compressed air into a mobile mixer which was used in combat to prepare napalm fire solutions. Here the free fatty acids are neutralized with caustic soda solution, also blown into the mixer, to form liquid soap. The caustic solution is prepared in tanks made from napalm drums and agitated by motor-driven paint stirrers.

As a final step, sediment is removed in a sand filter. The soap is then bottled or barreled, and labeled. If it were worth the trouble it could be reduced to a solid.

Essential steps in conversion of napalm, an aluminum soap, into a usable sodium soap are: Mixing with sulphuric acid (below), boiling with steam to complete hydrolysis (upper right), and mixing with caustic soda to neutralize fatty acids. Final product is black liquid with odor like tar soap

FROM THE VIEWPOINT OF THE EDITORS——

OUR CHANGING INDUSTRIAL GEOGRAPHY

DURING and immediately before the war large munitions plants were built in non-industrial areas. Many, who have wondered whether or not this trend would continue for peacetime construction, will find this question conclusively answered in the current issue of our sister publication, *Mill Supplies*.

Its editors have completed a statistical study that not only points to a distinct change in the pattern of industrial areas over that which existed prior to the war, but also shows a substantial increase in industrial building during the past 17 months as compared with that for the 36 months preceding the start of the defense program in 1940. This may well mean new sales opportunities for chemical engineering products and services.

Contracts awarded for industrial building in 1945 and for the first five months of 1946 amounted to $1,052 million as compared with $912 million during the three immediate prewar years 1937, 1938 and 1939. Furthermore, the publication points out that "the location of new plants is not following the prewar geographical pattern. Older industrial areas, while showing substantial absolute gains, are not accounting for as large a portion of the total as they did prewar. The trend of growth appears to be toward the Midwest, Southwest and Far West."

In a list of the states ranked in accordance with their percentages of the total industrial construction during the past 17 months, Texas takes first place with 11.76 percent. This compares with only 4.99 percent for the three years preceding the war. California is second with 11.56 percent as compared with 5.64 percent prewar. Third place goes to Ohio with 10.54 percent and fourth to Illinois with 8.42 percent.

Pennsylvania shows the largest percentage decrease—from 16.87 percent in 1937-38-39 to 7.76 percent in the Jan. '45-May '46 period. This does not mean, of course, that private industrial construction has reached the saturation point in Pennsylvania. As a matter of fact its $81,611,000 of new plants built during the last 17 months exceeds that of all except six other states. Likewise while the greatest percentage increase for a single area was for the seven Far West states, their total of $163,495,000 was considerably exceeded by the $183,312,000 of the five Middle Atlantic states. Again, in the southern states, where new construction contracts decreased nearly 5 percent from the prewar period, the actual postwar volume of $117,039,000 was more than twice as great as the volume of $54,927,000 for the New England states.

The most encouraging conclusion to be drawn from these figures is that industry is making rapid progress with its postwar construction program. Some parts of the country are pushing ahead of others, but practically all are advancing. And the end is not yet in sight because, as of May 1946, there was a rapidly growing backlog of proposed industrial projects amounting to $1,744,161,000, which is approximately twice the total volume for the last three prewar years, and almost equal to that for the entire eight-year period from 1932 through 1939.

THE RISING SPIRAL

A BUSINESS librarian tells us there is an increasing call of late for books on business cycles. What threatened to become a lost art (or science?) during the war has suddenly become of interest to laymen as well as economists. Our friend tells us that her visitors are beginning to talk about the rising spiral of wages and prices and to speculate on how soon we are coming to a repetition of the recession of 1921. They seem to think that we are going to have such a shakedown in 1947 before we can launch forth on a four or five-year cycle of good business.

We hope they are wrong, but events of the past few weeks indicate that this country is still far from any wage-price stabilization. The CIO threatened the Decontrol Board that unless all price controls were restored and prices rolled back, the unions would demand additional wage increases. A second round of reconversion wage adjustments is coming up in the automobile industry—or at least is being talked about by the Ford and Chrysler locals. Increased wages to meet increased prices, then higher prices to meet rising wages—so the spiral spins until something happens and we all suffer.

A POOR START ON A VITAL PROBLEM

THAT first "list of critical products and materials which will be used as a basis for certification" in arranging for deferment of irreplaceable production workers in industry is truly a fearful and wonderful thing. Those in the Civilian Production Administration who made it apparently had no concept of the basic problems of the chemical process industries. Chemical engineers and executives still have an educational job to do with the draft boards which has not been made easier by CPA's well intended but inadequate effort.

One or two examples will illustrate what we mean: The list of goods which are so important to the public includes industrial alcohols, but it does not mention any other organic chemicals. The list includes potash, which is desirable, but it makes no mention of nitrogen chemicals. The list provides for phosphate rock, desirably, but it says nothing about the needed sulphuric acid with which to convert that rock into superphosphate.

Apparently the first list to be used came from a quick

review of current worries by the housing specialists in CPA. We are reliably informed that no chemical advice was sought or used. Only under these circumstances can one understand how such a jumbled listing could have been achieved.

Perhaps the list as it stands is so bad, as a result of this method of production, that corrections soon will be forthcoming. We all have reason to hope so, for without important additions the list will not begin to do the job which Selective Service must accomplish in discriminating between those really "irreplaceable production workers" and those who would just like to escape service in our peacetime Army and Navy.

THE $10,000 CEILING

CONGRESS has voted itself higher wages. An increase to what is in effect a salary of $15,000 instead of the old $10,000 is a good thing not only because it may attract higher caliber personnel to our lawmaking bodies, but also because of its indirect effect on other congressional inhibitions.

An early and important benefit may be that the government ceiling on salaries for top scientific and engineering personnel may also be suitably raised. Only by that means can Congress expect that high-grade technical executives will look forward with hope and expectation to a permanent career in the public service. Only by that means will the government prevent the departure of many able investigators and administrators just at a time when they have reached the highest level of their value as public servants.

It will be a good thing if we all bring to the attention of congressmen and senators from time to time the need of a higher ceiling on professional salaries. Appropriate action may be expedited now that the congressmen themselves are not bumping their own heads against a lower ceiling.

ELIMINATE THE BOOBY TRAPS

MANY industrial establishments which have served their war purposes are badly contaminated with hazardous chemicals, explosives, or other materials which must be removed before these plants may be safely used or operated by others. War Assets Administration promises to decontaminate these potential booby traps. It is important that this be done. Those who seek to deal with surplus property which may require this attention should insist that the most thorough-going effort be made to eliminate all contamination before workers unacquainted with the war conditions are allowed to enter for remodeling or use. And, incidentally, it requires real skill to eliminate contamination without hazard to those involved in this essential but delicate task.

EXPLAINING THE PROFIT MOTIVE

DR. FRED I. KENT, president of the Council of New York University, was asked by his grandson to explain how there can be a profit on a transaction which is not taken from the work of some one else. His answer was such a clear exposition of this subject that it has recently been repeated, approximately as follows, in a course in better business management being sponsored by the General Electric Co.:

Dr. Kent points out that profit is the result of enterprise which builds for others as well as for the enterpriser, and he uses as an example a primitive community of 100 persons dwelling at the foot of a mountain. There is no water except at a spring at the top of the mountain. Therefore, every day all of the 100 persons climb to the top of the mountain to obtain water. It takes an hour to go up and back.

One of the hundred conceives the idea of digging a trough in the mountainside all the way down to the place where he has his habitation, and he builds the trough. Whereupon he says to the 99 others that, if they will give him the daily production of 10 minutes of their time, he will give them water from his basin. He will receive 990 minutes of the time of the other men each day, which will make it unnecessary for him to work 16 hours a day in order to provide his necessities of life. He is making a tremendous profit by his enterprise and gives each of the 99 others 50 additional minutes each day for himself. Thus, through the enterprise of one man, all of the 100 have profited, but not to the same degree.

With the encouragement of this profit, his imagination is stimulated and he conceives the idea of using the water to run a mill and to grind the corn for all of the other 99, if they will give him 1/10 of the time they save. And so it goes on, this one man with the profit motive as a stimulant conceives other ways of saving time, and in each case to the profit of himself and others.

As the community grew, it was realized that the children should be taught the ways of life. Since there was now more production capacity than required to provide for the bare necessities of life, it was decided to ask some members to cease providing for themselves, pay them, and set them to teaching the young. And as intelligence grew and there was more time available, art grew, and certain ones could be paid for entertaining the others.

Thus Dr. Kent explained in simple terms, based on sound and fundamental thinking, the possibilities of serving society through the profit motive. This is a hypothetical case, but it is none the less typical of the history of commerce and industry, and could be more widely used by all of us, should occasion arise.

FOR PROFESSIONAL GUIDANCE

AT VARIOUS times in his career every chemical engineer is called on for advice by young men who are thinking about entering our profession or by educators and others who want a brief description of the field, the kind of work chemical engineers do, how they are trained, and where and how they are employed. Several sources of such information are available but none quite so compact and useful as the recent booklet of the National Roster, entitled "Chemical Engineering as a Profession." This was written by Dr. W. T. Read with the assistance of other members of the National Roster and the U. S. Office of Education staffs in cooperation with many in the chemical engineering profession. It may be purchased from the Superintendent of Documents, U. S. Government Printing Office, for 10 cents a copy. Ask for "Vocational Booklet No. 3 (1946), U. S. Dept. of Labor."

A *Chemical Engineering* Report . . . .

Process Design and Operation Guided by the ECONOMIC BALANCE

The economic balance is recognized as a basic engineering concept. Its theme, maximum profit per unit time, should be a watchword in the design and operation of plants and processes and should constantly guide the efforts and thoughts of the chemical engineer. No chemical engineer, therefore, can afford to overlook the economic balance for his success might well hinge on understanding and applying the principles involved. This report outlines these principles and amplifies them in the form of actual examples from industry. It is taken from a chapter in Prof. C. G. Kirkbride's forthcoming book, Chemical Engineering Fundamentals, to be published soon by the McGraw-Hill Book Co., New York 18, N. Y.

One of the basic fundamentals of chemical engineering is the economic balance. Chemical engineering economics deals primarily with the determination of the point of maximum profit per unit time to do a given job. Essentially everything the chemical engineer does must be reduced eventually to a profit and loss basis. The economic balance, therefore, is at all times the guide of the practicing chemical engineer. Thus, he should determine as soon as possible the economic feasibility of any project on which he works. An employer is always vitally interested in any well supported proposal which shows how the earnings of the enterprise can be increased.

The philosophy in some of the foreign countries is quite different from that in this country inasmuch as processes are frequently developed for the sole purpose of making the country self-sufficient with respect to the product which the process will provide. Such developments were carried out before the recent war despite the fact that the cost of producing the product by the new process was substantially greater than its cost if purchased from industries of other countries. Such a controlled economy results in a higher cost. The system in this country is, in general, based on obtaining products at the lowest available cost even though from a foreign country. Thus, the chemical engineer who practices in this country must work toward production at competitive costs or his proposals will not fit in with the economic system. Of course, in the case of war the philosophy of national self-sufficiency usually becomes necessary.

ECONOMIC CONTRIBUTION

The success of the chemical engineer is directly related to his economic contributions to an enterprise. The chemical engineer who merely follows instructions will not be very successful. On the other hand, the chemical engineer will attain success who frequently effects a significant reduction in cost of production; makes a new design at lower cost; obtains an increase in production at a profit; leads the way to an increase in the yield of the more valuable products; shows how to produce a new product at a profit; makes a profitable trade; or obtains a valuable patent.

It is impossible to cover all the various aspects of chemical engineering economics in a single article. It will be feasible merely to introduce the philosophy of the economic balance and show by a few examples how it can be applied to the unit operations and chemical processes. For a broader treatment of chemical engineering economics the reader is referred to Tyler (Chemical Engineering Economics, McGraw-Hill Book Co., New York, 1938).

The chemical engineer in practice must familiarize himself with the economic status of the enterprise with which he is connected. This will enable him to determine the most likely possibilities for increasing the earnings of the business. If he has knowledge of the processing costs of the manufacturing plant, he will be in a position to determine those costs which, if reduced, would result in a large annual saving to the company. When attention is concentrated on reducing a small cost (dollars per year), the achievement is often relatively unimportant even though a substantial percentage reduction is realized. Instead, if attention is directed toward reducing a large cost, the saving may be considerable even though only a small percentage reduction in cost is effected. Consequently, it is usually preferable to direct attention toward the reduction of the larger, more important manufacturing costs.

If fuel is expensive, the average chemical engineer can usually make attractive eco-

nomic contributions by improving combustion efficiency. On the other hand, if fuel is relatively inexpensive, the probability is that a large saving in fuel cost could not be obtained by improving combustion efficiency.

NEW PRODUCTS

In the event that consideration is being given to marketing a new product or increasing production for an existing market, an accurate estimate of the market potential is necessary. The chemical engineer must have a reliable estimate of how much can be sold and the corresponding price before an economic appraisal can be made. If a reduction in the amount of products to be sold is made, a rather accurate estimate of the effect can usually be ascertained but when the volume of products is increased it is not always possible to predict the effect as accurately as desired. A slight increase in the supply may "break" the market and result in a loss. In case the sales demand is supplied by manufacturing a portion and the remainder is supplied by purchases from other manufacturers, the effect of an increase in production will replace the supply at highest cost. This almost always is the cost of the portion purchased from other manufacturers. The saving is therefore the difference between the cost of producing the additional amount of product and the cost of purchasing that amount from other manufacturers. This is a frequent case in the petroleum industry.

If there is a large supply of raw material at low cost, the situation presents an opportunity for large economic returns. A process for converting low value raw material into products of high value is what is needed. The individuals who can show how this can be done will have made an important economic contribution to their company. Frequently such a process constitutes an invention and a patent on the invention is a valuable asset of the company.

BASIS OF ECONOMIC BALANCE

The fundamental basis for all economic balances is maximum profit per unit time. Industry and business operate on a basis of earnings per unit time. Consequently, any economic appraisal must be on that basis. When an economic balance deals with reduction in manufacturing costs, the balance must be made so that profit or net earnings per unit time is the maximum. In the event that production per unit time is fixed (fixed gross income) as a result of a fixed market, the economic balance may be based on the minimum cost of production per unit time or per unit of production. This is valid, however, only when the gross income or its equivalent is fixed. If production is not limited by the market, the point of maximum profit will not necessarily be at the point of minimum unit cost of production. For example, a manufacturing plant can produce 100,000 units of production per day at a cost of $1 per unit but can produce 150,000 units per day at a cost of $1.10 per unit. The last increment of 50,000 units therefore costs $65,000 or $1.30 per unit. Assume that the volume of the market is sufficiently great so that the increase in production can be absorbed without any change in sale price. In this case it is apparent that as long as the price f.o.b. the manufacturing plant is above $1.30 per unit the earnings will be greater at the higher production rate even though the unit cost of production is higher.

OVER-ALL PROFIT

The chemical engineer who is engaged in technical service in a manufacturing plant will occasionally encounter cases in which one department will lose money by carrying out a certain operation but the enterprise as a whole will realize a significant increase in profit per unit time. In such a case the operation should be conducted so that the enterprise as a whole realizes maximum profit per unit time. Usually a department head will appreciate this fully and will be quite willing to accept the loss so that the firm can obtain the increase in earnings. The economic balance, however, must be well founded and fully supported by evidence before the department head will be willing to direct the operations of his department along the lines indicated by the economic balance. He must have a good argument to justify operating so that a loss to his department is incurred.

The same principle is frequently encountered in the operation of a given production unit. In order that the production unit may operate at maximum profit to the enterprise, it is often necessary to operate a single piece of equipment in the production unit well below its maximum efficiency. For example, it may be necessary to operate a furnace so that the fuel consumed per unit of production is considerably higher than would be the case if the production rate were reduced. But at higher rate the earnings per unit time of the enterprise is a maximum.

Thus, the economic balance will consist of a balance between costs and income per unit time so that the difference between them is a maximum. If production rate (gross income) is fixed or does not enter into the economic calculations, the balance may be made between the various costs so that the total cost per unit time or per unit of production is a minimum.

Another procedure very often used in an economic balance is based on incremental costs. This involves merely the calculation of changes in costs and changes in income which are a result of a change in a primary variable. In the example described above the incremental method was used. The change in cost for the increase in production of 50,000 units per day was $65,000. The primary variable in this particular case is the rate of production.

If consideration is being given to the installation of a new process in a manufacturing plant, it is usually much simpler to appraise it on the basis of differences or increments. A base case is established which represents the current situation. Then the effect of the new process in terms of production and costs is calculated. Often the effect on production includes a reduction in production of certain materials and an increase in the production of others. If the net changes in production and costs are known the economic balance can be made as a predicted difference in net earnings of the enterprise relative to the base case or existing situation.

TERMINOLOGY

There are several terms commonly used in chemical engineering economics which should be defined and discussed before proceeding with applications of the economic balance. Fixed charges or fixed costs are those which are not affected by changes in production rate. For example, the depreciation charges on an investment are fixed per unit time regardless of the use to which the process or equipment is put. Also a large portion of overhead charges is fixed because the salaries of most of the key men in the management will not be

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affected by changes in processing or changes in raw materials. For the purpose of economic balance it is almost always essential that the fixed costs be separated from the variable costs. The variable costs will be affected by changes in processes or changes in equipment. A good example of a variable cost is fuel consumed by a boiler. The rate of fuel consumption is directly related to the rate of steam generation. Thus, the fixed and variable costs should be segregated in order to make a sound economic appraisal. The chemical engineer must exercise caution when obtaining cost figures from accounting or bookkeeping records. Such costs frequently include cost items which are not pertinent to the economic balance and must therefore be eliminated from the cost figures used in the balance.

NEW INVESTMENTS

In economic balances which involve new investments, the fixed costs that are a result of the new investment must be considered. On the other hand, the fixed charges on existing investments usually are not pertinent because they will be constant per unit time and therefore will not affect the final conclusion. In other words, after an investment is made the fixed charges continue regardless of how the investment is used.

The most important factor concerning the possibility of making an investment is the length of time for the investment to pay for itself. This is commonly called the "pay-off-time" or the time for amortization. The maximum length of time which will be considered for amortizing an investment depends to a large extent on what the project is. In the case of ocean cargo vessels it is not uncommon for them to be amortized over a period of 20 years. On the other hand, a maximum time of 4 years for amortization of process equipment is not unusual. One of the chief reasons for this is that process equipment becomes obsolete at a rapid rate due to research and development which provides substantially more economical processes.

Although the board of directors of a corporation may not consider an investment in process equipment unless it will amortize itself within four years, after an investment is made the amortization may be at a somewhat lower rate than 25 percent per year. Usually such rates are fixed at maximum values by the government in connection with corporation income taxes.

UNIT OPERATIONS

Importance of considering the economic balance with respect to unit operations is obvious. While all unit operations cannot be discussed here the principles involved are similar in all of them. Those variables which affect the size and capacity of process equipment will be found to be the key to economic balances in the unit operation.

HEAT TRANSFER

There are many different economic balances in the field of heat transmission. Here as in essentially all applications in the unit operations, the economic balance usually reduces to a balance of costs to give the minimum operating cost.

One of the more common economic balances in heat transfer is the determination of the optimum thickness of insulation for hot (or cold) surfaces. This is a balance between reduction in the cost of the heat being lost and the cost of the insulation. The investment cost of insulation is made up of the labor for installing it and the cost of the material itself. The investment cost is charged off at a constant rate over the life of the insulation. The life of the insulation will depend primarily upon the type service to which it is put. It may range from a year to ten years.

INSULATION THICKNESS

A number of papers have been published on optimum insulation thickness. McMillan (Trans. ASME, FSP, 51, 349, 1929) reduced the economic balance for optimum insulation thickness to a graphical solution which was reproduced by Perry (Chemical Engineers Handbook, p. 996, 2nd Ed., McGraw-Hill Book Co., New York, 1941).

An example of optimum insulation thickness which involves the detailed calculations will help clarify the philosophy of application of the economic balance. A flat vertical surface is at a temperature of 500 deg. F. and the resistance to heat flow to the surface is nil. The surface is insulated with one inch of insulation but it is thought that considerable heat is being lost from the surface of the insulation to the atmosphere which averages about 70 deg. F. The insulation has a thermal conductivity of 0.040 B.t.u. per deg. F. per ft. per hr. The heat transfer coefficient for the air film at the surface of the insulation is 4.0 B.t.u. per deg. F. per sq.ft. per hr. and may be assumed to be constant for any thickness of insulation. (This assumption is not quite valid because radiation and natural convection increase with the surface temperature. But since these factors are beyond the scope of this article the assumption is made merely to simplify the presentation.)

If insulation costs, $0.40 per sq.ft. per inch of thickness installed, and heat loss is at a cost of $0.50 per 1,000,000 B.t.u., what should the thickness of insulation be if the insulation is amortized in 4 years? The thickness should be based on operation 24 hours per day 365 days per year. Insulation is available as boards of one inch thickness.

On the basis of 100 sq.ft. of surface the heat loss would be: B.t.u. per hr. $= UA\Delta t = (100)\ (500 - 70)U = 43{,}000\ U$ or $U = 1/[1/4.0 + L/(1.2)\ (0.04)] = 1/(0.25 + 2.08\ L)$ where U = heat transfer coefficient, A = area in sq.ft., t = temperature difference, and L = thickness of insulation in inches. Then heat loss $= [43{,}000/(0.25 + 2.08\ L)]$ [B. t. u. per hr.] or $(43{,}000)\ (24)\ (365)/(1{,}000{,}000)\ (0.25 + 2.08\ L) = 376/(0.25 + 2.08\ L)$ million B. t.u. per yr. Therefore cost of heat loss $= 188/(0.25 + 2.08\ L)$ dollars per year.

Since the insulation thickness will be made up by installing layers of one inch thickness, the investment cost for insulation $= (100)\ (0.40)\ L = 40\ L$. The cost of the insulation is amortized over a period of four years making the annual cost of insulation $= 40\ L/4 = 10\ L$. Total annual cost of heat loss plus insulation is therefore $C = 188/(0.25 + 2.08\ L) + 10\ L$. Minimum cost for various thicknesses can be determined by assuming thicknesses L in one inch increments and calculating the value of C in dollars per year per 100 sq.ft. of surface.

L	C
1	90.80
2	62.60
3	59.00
4	61.90
5	67.65

Thus, minimum cost is obtained with a 3 in. thickness of insulation.

DOWN TIME

Another type economic balance in the field of heat transmission is the determination of the optimum time for cleaning heat exchangers, condensers, etc. This is usually a balance between costs of heat loss and cost of cleaning such that the minimum total cost is realized. Some times, however, process factors enter into the balance which are of great importance. For example, an overhead condenser for a fractionating column may become fouled so that sufficient reflux cannot be obtained to give the desired fractionation. In such a case the loss sustained by the reduction in effectiveness of fractionation must be considered in the balance.

Actually, an economic balance should be made in an original design to determine the size of heat exchanger, condenser, etc. to be installed. Such a balance must be predicated upon an estimated rate of fouling of the heat transfer surface. This will usually result in a surface area sufficiently large so that the heat exchanger need not be cleaned until the entire manufacturing unit is shut-down for routine inspection and cleaning. If sufficient heating surface was not installed and the production ca-

pacity of the entire manufacturing unit is limited by a fouled heat exchanger, it is usually quite profitable to install additional heating surface. The amount of additional surface should be determined by economic balance.

MATERIALS HANDLING

The philosophy of the economic balance is very important in the unit operation, materials handling. The optimum amount of storage and the optimum method of transportation of both raw materials and finished products should be arrived at by economic balance studies.

For example, a company may have manufacturing plants at two different locations which produce the same product. In such cases the question arises as to which market should be supplied by each plant. The optimum is a balance of manufacturing cost and transportation cost for each plant. Frequently the manufacturing cost at one plant will be somewhat less than at the other owing to various conditions which prevail. Thus, if transportation rates are the same from each plant, the plant which has the lower manufacturing cost should supply the market beyond the equidistant locus between the two plants. In effect the division of the market should be based on the locus of identical total cost for each plant. All this, of course, is predicted upon the assumption that each plant has sufficient production capacity to handle the economical portion of the market.

Another type economic balance in connection with transportation is one which occurs when a company is handling part of its transportation with its own facilities and the remainder by means of other conveyances. The question that presents itself under such conditions is what trips should be handled by company-owned facilities and which should be handled by other conveyances. For example, a petroleum company may transport a large part of its crude oil by company-owned barges and the remainder which must be moved by barges may be handled under contract by a transportation company. Since the company-owned barges could make any of the regular trips the company chooses to have made, it is desirable that they be used to maintain the total transportation cost at the minimum.

CHEMICAL PROCESSES

Usually economic balances which deal with chemical processes are of greater importance than those on the unit operations. There is greater chance of economic contributions with economic balances on processes. As a matter of fact, when a design of a new manufacturing unit is being made it is ordinarily of great economic importance to get the unit into production as soon as possible because the earnings upon which the unit was justified are usually quite large. Thus, it is questionable economy to delay the installation of a unit in order to make detailed economic balances during the design of the unit. It is usually preferable to allow liberal safety factors. For this reason economic balances which involve the unit operations are made in a general form so that optimum size of equipment can be specified quickly. An example of this already cited is the graphical chart prepared by McMillan for quick determination of optimum insulation thickness.

COMBUSTION

The feature of greatest economic importance in the combustion of a fuel is the cost of heat utilized for the desired purpose. One fuel may have a substantially higher heating value than another but the one which provides the more useful heat per dollar is preferred from an economic standpoint if other factors are equal.

There are other things, too, which must be considered in the evaluation of fuels. One of these is the cost of handling. For example, a heavy fuel oil which becomes plastic at moderate temperatures (such as 40 deg. to 60 deg. F.) would cost more to handle in cold climates than a fuel oil which remains fluid at −20 deg. F. Special provision for heating the oil of high pour point must be provided in the cold climate so that it will not solidify in the lines and burners. Also, another factor of great importance is the ash in the fuel. Some ash has a bad effect on refractory brick work of furnaces. It reacts chemically with the refractory and produces a product of relatively low melting point. The result is that the refractory bricks rapidly disintegrated. This entails high maintenance cost on the furnaces which is directly chargeable against the fuel with the offending ash.

FUEL IMPURITIES

Still another factor is the sulphur content of fuels. The sulphur burns to SO_2 a large part of which will oxidize to SO_3 if in contact with any rust (iron oxide). In this case it is essential that the flue gases be maintained at a sufficiently high temperature so that the SO_3 and H_2O of the flue gases do not combine and condense so that they come in contact with any steel work including the smoke stack. The minimum temperature which must be maintained can be calculated on the basis of the partial pressures of the SO_3 and H_2O in the flue gases. This some times results in poorer fuel economy in order to maintain the necessary temperature of the flue gases. There are several more factors such as these which are discussed fully by Haslam and Russell (Fuels and Their Combustion, McGraw-Hill Book Co., New York, 1926).

The value of fuel varies rather widely over the United States. In the Great Lakes Region and in the East Coast Region fuel is expensive. In the Southwest, however, fuel is fairly inexpensive although its value will probably increase with time. Up until about 1940 it was relatively common to see petroleum companies burning huge quantities of fuel gas at torches in order to dispose of it. It was a byproduct from their processes which could not be utilized with immediate profit. In such cases it is apparent that fuel was valueless and nothing could have been gained by the chemical engineer in improving the thermal efficiency of furnaces. It would have resulted merely in more fuel to burn at the torches. This situation has been corrected in some plants, however, by installing processes to utilize or conserve the gas.

FUEL ECONOMY

If fuel is valuable, a large economic contribution can usually be effected by the chemical engineer in maintaining proper combustion conditions. This is illustrated by the following example. A manufacturing plant is being designed for location where no existing manufacturing facilities exist. The steam demand will be supplied by a boiler house which will be installed at the time of the manufacturing facilities. Fuel of 12,500 B.t.u. per lb. net heating value will be available at $4.50 per ton delivered at the boiler house. The cost of steam will consist of fixed charges plus variable cost. The annual fixed charges which include amortization of investment, overhead, labor, maintenance, etc. will be $24.82 per rated boiler horsepower.* The variable cost will consist entirely of fuel used to generate steam. The boilers being considered are guaranteed to perform as follows:

Percent of Rated Boiler Hp.	Thermal Efficiency
100	76.0
180	74.9
200	74.2
220	73.2
240	71.8
260	70.1
280	67.9
300	65.0

The thermal efficiency is 100 times the fraction of the net heating value of the coal which is transferred for the evaporation of water into steam.

* A boiler horsepower is equivalent to the evaporation of 34.5 lb. of water per hr. from and at 212 deg. F. or 33,475 B.t.u. per hr. Rated boiler horsepower is based on the amount of steam the boiler was designed to produce. The steam production rate can be increased above the rated capacity at the expense of thermal efficiency. It is common practice therefore to quote the actual performance of a boiler in terms of percentage of its rated capacity.

Table I—Total Costs of Steam for Different Values of *R* (Percent of Rated Boiler Hp.) and *E* (Thermal Efficiency)

		365 Days Per Yr. and 24 Hr. Per Day			40 Hr. Per Week and 50 Weeks Per Yr.	
R	*E*	603/*E*	283.5/*R*	Total	1240/*R*	Total
100	76.0	7.93	2.835	10.765	12.40	20.33
180	74.9	8.05	1.575	9.625	6.89	14.95
200	74.2	8.12	1.418	9.538	6.20	14.32
220	73.2	8.23	1.287	9.517	5.63	13.86
240	71.8	8.39	1.180	9.570	5.16	13.55
260	70.1	8.60	1.090	9.690	4.77	13.37
280	67.9	8.88	1.013	....	4.43	13.31
300	65.0	9.27	0.945	....	4.13	13.50

What would be the most economical percentage of rated boiler horsepower to operate the boilers if they are operated 365 days per year and 24 hours per day? What should it be if they are operated 40 hr. per week and 50 weeks per year?

STEAM COST

The pertinent item is the cost of steam. Obviously manufacturing departments wish to obtain their steam demands at minimum cost. The demands are fixed on a time basis. Thus, the objective is to obtain steam at minimum cost per unit quantity. On the basis of 1,000 boiler hp.hr. the cost of steam = (fixed cost + variable cost)/boiler hp.hr. Where R = percent of rated boiler horsepower then fixed cost at 365 days per yr. and 24 hr. per day = (24.82) (1,000) (100)/(365) (24) (R) = 283.5/R or at 40 hr. per week and 50 weeks per yr. fixed costs = (24.82) (1,000) (100)/(50)(40) (R) = 1240/R. Where E = thermal efficiency, variable cost or fuel cost = (33,475) (1,000) (100) (4.50)/(12,500) (E) (2,000) = 603/E. This makes the total costs at 365 days per yr. and 24 hr. per day = 283.5/R + 603/E and at 40 hr. per week and 50 weeks per yr. = 1,240/R + 603/E.

The total costs can be calculated for each value of R and E as guaranteed. They are given in Table I. Thus, the most economical rated boiler horsepower for operation of the boilers is 220 percent if operated 365 days per year and 24 hr. per day or 280 percent if operated 40 hr. per week and 50 weeks per year.

The situation which existed in the above example did not require that existing facilities be considered in the economic balance. Often, the installation of new facilities is merely an expansion of existing facilities. In such a case the optimum operation of existing facilities will depend upon the economics of the proposed new facilities.

ELECTROLYSIS

Many important industrial chemicals are produced by electrolysis. The major supply of caustic soda is by the electrolysis of common salt (NaCl). Also oxygen and hydrogen of high purity are produced by the electrolysis of water.

In the production of caustic soda the salt and water are ionized so that Na^+, Cl^-, H^+ and OH^- ions are present. The electrolysis is carried out in cells each of which is divided into an anode and a cathode compartment by a porous diaphragm. The NaCl solution is charged to the anode compartment and caustic soda solution withdrawn from the cathode section. Liquid must therefore pass through the diaphragm. The Na^+ migrates to the cathode and there takes on an electron to form free sodium which immediately reacts with water to form hydrogen and caustic soda. Thus, at the cathode

$$2Na^+ + 2(-) \longrightarrow 2Na$$
$$2Na + 2H_2O \longrightarrow 2NaOH + H_2\uparrow$$

In like manner the Cl^- migrates to the anode and gives up an electron so that chlorine is liberated. Thus, at the anode

$$2Cl^- \longrightarrow Cl_2\uparrow + 2(-)$$

Theoretically the amount of electricity required to decompose one gram equivalent of a compound is 96,500 coulombs. Hence 96,500 coulombs is theoretically required to decompose one gram mol of NaCl or 4.38×10^7 coulombs is required for one pound mol of NaCl. Actually, however, slightly more electricity is required. The current efficiency is 100 times the ratio of the desired production to the amount which theoretically should be produced. Usually in an electrolytic process there are various secondary reactions which occur. Some will occur at the anode whereas others will occur at the cathode. The extent of such reactions will not necessarily be the same at each electrode so the current efficiency will usually be different at the anode than at the cathode. Consequently the current efficiency for caustic soda (cathode) production will probably be different from the current efficiency for chlorine production.

The current density is the number of amperes per square foot perpendicular to the direction of flow of electricity. It is frequently expressed as amperes per square foot of diaphragm surface.

The electric energy required to decompose a compound is the product of the coulombs and voltage. Since coulomb is an ampere-second, the product is watt-seconds. Theoretically the electric energy required to decompose one gram-equivalent is 96,500 multiplied by the voltage. The following example illustrates the application of economic balance to this process.

HYDROGEN & OXYGEN

Hydrogen and oxygen gases are to be produced by the electrolysis of dilute NaOH solution in a number of diaphragm cells. The electrolyte is fed separately to each cell and the gas streams from the cells are collected in separate O_2 and H_2 manifolds. The gases are purified by passing them through hot tubes. The current flows through all of the cells in series. The performance data in Table II are typical for these cells.

Table II—Electrolytic Cell Performance Data

Current Density Amps per Sq.Ft. of Diaphragm	10	25	50	100	200	300
Voltage per cell	1.8	2.1	2.4	2.9	3.5	4.8
H_2 current eff.	98.5	98.4	98.2	97.2	96.0	92.0
O_2 current eff.....	92.2	92.1	89.9	89.4	88.3	84.8

The total investment cost of the cells is $7.50 per sq.ft. of diaphragm and the total annual fixed charges are 40 percent of the investment cost. The cells operate 10 hours per day, 300 days per year. The labor is $10 per day and incidental costs are $1 per day. The cost of electric power is $0.030 per kw.

(a) The manufacturing department requires 10,000 cu.ft. per day of dry H_2 gas at 760 mm. and 20 deg. C. How many square feet of diaphragm surface should be installed? What is the cost of H_2?

(b) After the cells are installed and in operation it is found that any excess H_2 can be sold for $0.005 per cu.ft. and all the oxygen can be sold at $0.006 per cu.ft. How much H_2 and O_2 is it profitable to sell if the 10,000 cu.ft. per day of H_2 required by the manufacturing department is credited to the cell room at the price calculated in (a)?

On the basis of 1 day operation: (a) H_2 production = (10,000) (273)/(359) (293) = 25.9 mols. Equivalents of H_2 = (2) (25.9) = 51.8 lb.-equivalent. Electricity = (51.8) (4.38×10^7) = 2.27×10^9 coulombs per day (theoretical) = (2.27) (10^9)/(10) (3600) = 63,000 amp. (theoretical). From this the data in Table III are calculated. The minimum cost of the hydrogen is therefore $7.03 per

Table III—Summary of Cost Data of H_2 Production

Volts	Density	Actual Watts Per Sq. Ft.	Actual Amps.*	Kw.	Elect., $ Per Day	Diaph. Sq. Ft.	Fixed Cost, $ Per Day	Total** Cost $ Per Day
1.8	10	18	64,000	1152	34.50	6400	64.00	109.50
2.1	25	52.5	64,100	1347	40.40	2560	25.60	77.00
2.4	50	120	64,400	1545	46.40	1290	12.90	70.30
2.9	100	290	64,900	1883	56.50	650	6.50	74.00
4.5	200	700	65,600	2295	68.90	328	3.28	83.18
4.8	500	2400	68,500	3290	98.70	137	1.37	111.07

* Actual amps. = theoretical amps/(H_2 eff./100). ** Includes elec. + fixed + labor + incidental.

1,000 cu.ft. Total diaphragm surface required is 1,290 sq. ft.

(b) Proper solution to this part must be based on profit per unit time. Let D = current density (amp. per sq. ft.) $E_H = H_2$ current efficiency, $E_o = O_2$ current efficiency, V = voltage per cell. Mols of H_2 prod. = (1290) (D) (36,000) (E_H)/(4.38 × 10^7) (2) (100) = 5.3×10^{-8} DE_H. Cu.ft. of H_2 at 20 deg. C. and 760 mm = (5.3×10^{-8} DE_H) (359) (293)/273 = 2.04 DE_H. Theoretically only ½ mol of oxygen is obtained per mol of H_2. Thus, cu.ft. of O_2 at 20 deg. C. and 760 mm = 1.02 DE_o, profit = income − cost per unit time. Income = 70.30 + 5(0.00204 DE_H − 10.0) + (6) (0.00102 DE_o), cost = (1,290) (D) (V) (10) (0.03)/1,000 + 12.90 + 11.00, and profit = 0.0102 DE_H + 0.00612 DE_o − 0.387 VD − 3.60. Therefore:

D	E_H	E_o	Profit per Day
50	98.2	89.9	$27.55
100	97.2	89.4	$38.20
200	96.0	88.3	$29.40

The most profit is with a current density of 100 amps. per sq.ft. Therefore, H_2 to be sold = 2.04 $E_H D$ − 10,000 = 9,600 cu.ft. per day, O_2 to be sold = 1.02 $E_o D$ = 9,100 cu.ft. per day.

PROCESSING PETROLEUM

Processing of petroleum involves many different chemical processes. There are certain principles in the economic appraisal of such processes and the economic evaluation of petroleum and its products that are generally applicable in the petroleum refining industry. Rather than confine the discussion of economic balance on refining of petroleum to a given type process, it would therefore be preferable to discuss those principles which are more generally applicable.

Cost of petroleum products is made up chiefly of the cost of raw material, cost of manufacturing, taxes and cost for amortization of investment. The cost of raw material (crude oil) is by far the largest of these costs. Since there are many different kinds of crude oil available at almost as many different prices, it is most important that the refinery process the crude oil which provides the greatest profit per unit time. The value of a given crude oil will depend upon the processes available for refining it.

A multitude of products is produced from crude oil but gasoline is the one of greatest volume as well as greatest source of income to the petroleum industry. Crude oil can be processed directly to ultimate yields (gasoline, fuel gas and black fuel oil) or it can be processed so that domestic fuel oil, kerosene, solvents, paraffin, asphalt and a great many other products are produced. Furthermore, it is entirely feasible from a process standpoint to convert crude oil into gas, gasoline and petroleum coke. Likewise such products as kerosene, domestic fuel oil and paraffin can be processed to ultimate yields or to gas, gasoline and coke.

Value of any crude oil will depend upon the value of the products which can be produced from it per unit time. If a refinery has a greater capacity for producing products than the market demands, a convenient method of evaluating crude oils is on the basis of ultimate yields.

GASOLINE COST

Cost of gasoline of a given quality is equal to the cost of the crude oil minus the value of the black fuel oil, minus the value of fuel gas, plus the processing cost. Thus, if G = cost of gasoline ($ per gal.), Y_g = yield of gasoline (vol. percent), F = value of black fuel oil ($ per gal.), Y_{fo} = yield of black fuel oil (vol. percent), F_g = value of fuel gas (E per gal. eq. fuel oil), Y_{fg} = yield of fuel gas (vol. percent eq. fuel oil), C = cost of crude oil ($ per gal), and P = processing cost ($ per 100 gal. of crude). Then, $G = (100\,C - Y_{fo}F - Y_{fg}F_g + P)/Y_g$. The cost of gasoline of desired quality should be the minimum. The crude oils should therefore be selected for processing on this basis.

If a refinery has a large source of crude oil of a given kind which can be processed at a profit, it is convenient to use it as a reference with which all other crudes are compared. For example, C represents the cost of the reference crude oil for a refinery which is considering the purchase of another crude oil, A. It is essential, therefore, that the cost of gasoline A not be greater than the cost from the reference crude oil. Otherwise it would be preferable from an economic standpoint to continue processing the reference crude oil. Thus, the value of maximum amount that can be paid for crude oil, A, is given by the following equation which corresponds to the same unit cost of gasoline from crude oil, A, as from the reference crude oil: $A = (100\,C - Y_{fo}F - Y_{fg}F_g + P)/Y_g = [100\,A - (Y_{fo}F)_A - (Y_{fg}F_g)_A + P_A]/(Y_g)_A$ or $A = [(Y_g)_A/Y_g]\,[100C - Y_{fo}F - Y_{fg}F_g + P]/100 + [(Y_{fo}F)_A + (Y_{fg}F_g)_A - P_A]/100$.

Also, the value of intermediate as well as finished products can be determined in the same way as the value of the crude oil was calculated. In other words, this is the value based on replacing the incremental crude oil with the intermediate or finished product for gasoline production. The incremental crude oil is the one which results in the highest cost for gasoline and the amount processed can be reduced or increased as the situation demands. It is the "come and go," therefore, which is used to keep production in balance with the market demand.

For instance a petroleum refinery is producing a domestic fuel oil which could be processed to gasoline, black fuel oil and fuel gas with the following yields:

	Vol. Percent	Deg. API
Domestic fuel oil....	100.0	34.0
Products:		
Gasoline.....	62.0	53.0
Black fuel oil.....	30.7	10.5

The incremental crude oil of the refinery can be processed to ultimate yields as follows:

	Vol. Percent	Deg. API
Crude oil.....	100.0	35.0
Products:		
Gasoline.....	69.0	50.0
Black fuel oil.....	22.7	10.5

The quality of the gasoline in each case is the same.

The cost for processing incremental crude to its ultimate yields is $0.28 per 100 gal. and the cost of processing the domestic fuel oil to its ultimate yield is $0.32 per 100 gal. The cost of incremental crude oil delivered to the refinery is $1.42 per bbl. (42 gal.). The value of black fuel oil is $0.95 per bbl. and the value of fuel gas on a heating value basis is $0.15 per 100 lb. of fuel oil.

What is the value of the domestic fuel oil as replacement for crude oil in gasoline production? The refinery has an excess capacity for producing all the products marketed.

Yields as given, do not include the gas which must be calculated by mass balance, and are shown in Table IV.

Table IV—Product Yields from Domestic Fuel Oil and Crude

	Gal.	Deg. API	Lb. Per Gal.	Lb.
Crude oil.....	100.0	35.0	7.076	707.6
Products:				
Gasoline.....	69.0	50.0	6.184	427.0
Black fuel oil.....	22.7	10.5	8.299	188.6
Gas (by diff.).....	.....	.....	.....	92.0
Dom. fuel oil.....	100.0	34.0	7.119	711.9
Products:				
Gasoline.....	62.0	58.0	6.216	385.7
Black fuel oil.....	30.7	10.5	8.299	255.0
Gas (by diff.).....	.....	.....	.....	71.2

Next, the cost of gasoline from the incremental crude will be calculated. $G = (100\,C - 22.7\,F - 0.92\,F_g + 0.23)/69.0 = 1.45\,C - 0.329\,F - 0.0134\,F_g + 0.00405$ where C = cost of crude oil ($ per gal.), F = value of black fuel oil ($ per gal.), F_g = value of fuel gas ($ per 100 lbs.), and G = cost of gasoline ($ per gal.). The next step is to compute the cost of gasoline from domestic fuel oil. $G = (100\,D - 30.7\,F - 0.712\,F_g + 0.32)/62.0 = 1.615\,D - 0.495\,F - 0.0115\,F + 0.00516$ where D = value of domestic fuel oil ($ per gal.).

Since the cost of gasoline from domestic fuel oil must not exceed that of gasoline from incremental crude oil: $1.615\,D - 0.495\,F + 0.0115\,F_g + 9.00516 = 1.45\,C - 0.329\,F - 0.0134\,F_g + 0.00405$ and $D = 0.897\,C + 0.103\,F - 0.0012\,F_g - 0.00069$. Thus, the above equation gives the value of domestic fuel oil on the basis

of replacement of crude oil for gasoline production. On the basis of values of C, F and F_g quoted in the statement of the problem $D = (0.897)(0.0338) + (0.103)(0.0226) - (0.0012)(0.15) - 0.00069 =$ $0.0317 per gal. Therefore, unless the refinery can sell the domestic fuel oil at a price greater than $0.0317 per gal. it would be more economical to process it to its ultimate yields and replace incremental crude oil.

FINISHING

In the event that there were any finishing costs, such as chemical treatment, for the domestic fuel oil to make it acceptable for marketing, these costs would have to be added to the value of D to obtain the value of the finished domestic fuel oil below which it would be uneconomical to sell.

Thus far the only situation considered are those which involve excess producing capacity for all products marketed. In case a refinery is unable to produce a sufficient quantity of a given product to supply the market, the additional quantity required is usually purchased from other refineries. This must therefore be considered in any economic balance which involves a change in the production rate of the product. Ordinarily the price that must be paid for purchases from other refineries is above the value of the product on a crude replacement basis for gasoline production. In other words, if the product were processed to its ultimate yields, its value based on incremental crude would be less than the price paid to the other refiners. Hence, any change in processing such as another crude oil which would increase the production of the product that the refinery cannot supply completely would result in a reduction of outside purchases. This would effect a reduction in the cost of supplying the market with this product which should be credited to the new crude oil (or whatever the change is) in its evaluation.

PROCESS EVALUATION

A sound basis for evaluating a new raw material or a new process is to set up a base case which represents the current operations and then determine the change in each item that affects the economic situation. The changes in the pertinent items should be calculated relative to the base case. In this way the increase or decrease in profit per unit time can be determined. This is the "incremental method" which was described earlier. It is fundamental and is applicable to any change whatever in processing.

An example will illustrate another type of problem. The incremental crude oil, which a refinery is processing, costs $1.16 per bbl. (42 gal.) and the market for black fuel oil is strong at $0.80 per bbl. The value of fuel gas is $0.30 per bbl. of equivalent 8 deg. API fuel oil on a net heating value basis. The ultimate yields from the incremental crude oil are as follows in volume percent: Gasoline, 67.1; black fuel oil, 23.6 at 8.0 deg. API; gas (eq. 8 deg. API Oil), 11.8. There is insufficient producing capacity to meet the gasoline demand. Consequently consideration is being given to increasing the gasoline production by increasing the deg. API gravity of the black fuel oil which will permit more crude oil to be processed. This effect is a result of elimination of heavy gas oil in the black fuel oil which will be replaced with higher quality raw material from the increase in crude oil processed.

YIELDS

The change in crude oil charge rate and the change in yields versus the deg. API gravity of the black oil are estimated to be as shown in Table V. The processing cost will remain constant on a daily basis except for fuel consumption which will be 7.5 percent by volume of crude oil expressed as equivalent 8 deg. API fuel oil on a heating value basis. The refinery is purchasing gasoline from other refiners at 5.75c. per gal. to satisfy that part of the demand which cannot be produced by the refinery. What is the optimum deg. API black fuel oil to maintain?

Table V—Variation of Yields and Charge Rates for Different Deg. API Crudes

Black Fuel Oil Deg. API	Relative* Crude Rate	Yields in Vol. Percent Gasoline	Black Fuel Oil	Gas**
8.0	1.00	0	0	0
10.0	1.05	−1.3	1.8	−0.5
12.0	1.08	−2.9	3.9	−1.0
14.0	1.09	−4.5	6.0	−1.5

* Ratio of crude charge rate to charge rate at 8 deg. API black fuel oil.
** Equivalent of 8 deg. API fuel oil on heating value basis.

On the basis of time required to process 100 bbl. of crude oil with 8 deg. API black oil elimination, the first step is to determine the yields and volume of products at each deg. API of black fuel oil as shown in Table VI. Since the processing cost (excluding fuel) on a daily basis is constant, it can be disregarded.

Table VI—Yields and Volume of Products Using Different Deg. API Black Oil

Deg. API	Crude Bbl.	Gasoline Vol. Per cent	Gasoline Bbl.	Black Fuel Oil Vol. Per cent	Black Fuel Oil Bbl.	Gas (Eq. Vol. Per cent	Gas (Eq. Bbl.
8	100	67.1	67.1	23.6	23.6	11.8	11.8
10	105	65.8	69.0	25.4	26.6	11.3	11.9
12	108	64.2	69.3	27.5	29.7	10.8	11.65
14	109	62.6	68.3	29.6	32.3	10.3	11.23

The next step is to calculate the difference between cost of crude oil plus fuel consumed and realization on products for each deg. API. These are shown in Table VII. It is noted that the maximum difference between costs and realization occurred at 10 deg. API. By plotting this difference versus deg. API it appears that the optimum gravity is between 10.5 deg. and 11 deg. API.

CONCLUSION

The economic balance is the guide of the chemical engineer in practice. Everything the chemical engineer does must be reduced eventually to a profit and loss basis. If the results cannot stand this test they will have little application.

The fundamental basis of the economic balance is maximum profit or earnings per unit time. When gross income is fixed per unit time, the economic balance may be made on the basis of minimum cost per unit time or per unit product. The latter usually holds true for economic balances on the unit operations but frequently is involved for economic balances on chemical processes. It is, therefore, a good policy always to examine an economic situation critically to determine whether the balance may be made on the basis of minimum cost or if it must be based on maximum profit per unit time.

Table VII—Difference Between Cost of Crude Plus Fuel Consumed and Realization on Products for Various Deg. API Crudes

Costs:	Bbl.	Dollars per Bbl.	Dollars
Crude oil	100	1.16	116.00
Gas for fuel	7.5	0.30	2.25
Total	....	....	118.25
Realization:			
Gasoline	67.1	2.415	162.00
Black fuel oil	23.6	0.80	18.90
Gas(eq.)	11.8	0.30	3.54
Total	....	....	184.44
Difference	....	....	66.19
At 10° API:			
Costs:			
Crude oil	105.0	1.16	121.70
Gas for fuel (eq.)	7.86	0.30	2.36
Total	....	....	124.06
Realization:			
Gasoline	69.0	2.415	166.70
Black fuel oil	26.6	0.80	21.25
Gas (eq.)	11.9	0.30	3.57
Total	....	....	191.52
Difference	....	....	67.46
At 12° API:			
Costs:			
Crude oil	108.0	1.16	125.30
Gas for fuel (eq.)	8.1	0.30	2.43
Total	....	....	127.73
Realization:			
Gasoline	69.3	2.415	167.50
Black fuel oil	29.7	0.80	23.75
Gas (eq.)	11.65	0.30	3.50
Total	....	....	194.75
Difference	....	....	67.02
At 14° API:			
Costs:			
Crude oil	109	1.16	126.50
Gas for fuel (eq.)	8.16	0.30	2.45
Total	....	....	128.95
Realization:			
Gasoline	68.3	2.415	165.00
Black fuel oil	32.3	0.80	25.85
Gas (eq.)	11.23	0.30	3.37
Total	....	....	194.22
Difference	....	....	65.27

CHEMICAL ENGINEERING PLANT NOTEBOOK—

THEODORE R. OLIVE, Associate Editor

$50 CASH PRIZE FOR A GOOD IDEA!

Until further notice the editors of *Chemical Engineering* will award $50 cash each month to the author of the best short article received that month and accepted for publication in the "*Chemical Engineering Plant Notebook*." The winner each month will be announced in the issue of the next month: e.g., the September winner will be announced in October, and his article published in November. Judges will be the editors of *Chemical Engineering*. Non-winning articles submitted for this contest will be published if acceptable, in that case being paid for at applicable space rates. (Right is reserved to make no award if no article received is of award status.)

Any reader of *Chemical Engineering*, other than a McGraw-Hill employee, may submit as many entries for this contest as he wishes. Acceptable material must be previously unpublished and should be short, preferably not over 300 words, but illustrated if possible. Neither finished drawings nor polished writing are necessary, since only appropriateness, novelty and usefulness of the ideas presented are considered.

Articles may deal with any sort of plant or production "kink" or shortcut that will be of interest to chemical engineers in the process industries. In addition, novel means of presenting useful data, as well as new cost-cutting ideas, are acceptable. Address Plant Notebook Editor, *Chemical Engineering*, 330 West 42nd St., New York 18, N. Y.

AUGUST WINNER!

A prize of $50 in cash will be issued to

J. A. JAFFE and L. H. CIRKER

Plastics Department
E. I. du Pont de Nemours & Co.
Arlington, N. J.

For an article dealing with a novel electrical indicating device for gas holder "lift" that has been judged the winner of our August contest.

This article will appear in our October issue. Watch for it!

July Contest Prize Winner

NO VACUUM PUMPS NEEDED FOR THIS SIPHON FOR DISCHARGING ACID TANK CARS

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Mechanical Engineer
Brasov, Rumania

DISCHARGING acid from tank cars is often rather inconvenient, especially when it is necessary to do so through the dome of the car. Since safety codes discourage the use of compressed air in the movement of acids, it therefore becomes necessary to employ expensive vacuum installations which may be hard to maintain.

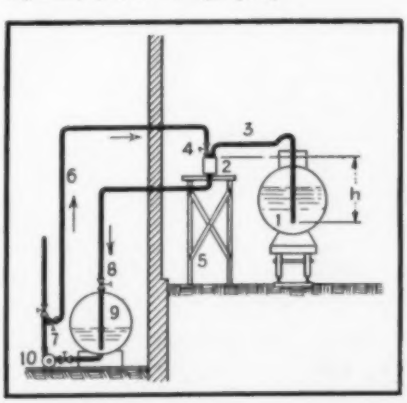
The accompanying drawing shows a simple discharge appliance based on the siphon principle which can be rigged up with ease by any pipe fitter. In brief the idea is to use an auxiliary vessel containing acid to start the siphon, after the vessel has been filled by the same pump that is used to transfer acid to other points in the plant.

The auxiliary vessel (2) is elevated at a suitable height above the car unloading dock and connected with the acid receiving tank (9) by means of two pipes. Tank car (1), which is to be discharged, is connected with vessel (2) by means of the removable siphon pipe (3) which is 2 to 3 in. in diameter. Then the auxiliary vessel is filled through pipe (6) along the dotted arrows by means of pump (10), drawing acid from receiving tank (9). When the installation is started up initially, of course, vessel (2) must be filled directly with acid. Then cock (4) is closed and cock (8) is opened. As the contents of vessel (2) discharges this creates sufficient vacuum to start the siphon action through pipe (3), vessel (2) and pipe (8) into receiving tank (9). Pump (10) is then used to transfer the acid as needed to other parts of the plant, and it is also used to refill vessel (2) when the next car is to be discharged.

Discharge of a tank car takes about 30 minutes (evidently refers to one of the small European cars.—Editor) when a pipeline of 2 in. size is used. Larger pipes will of course require correspondingly shorter time. The system is simple, cheap and always ready for use. It requires no pumping energy except for the negligible amount used in filling vessel (2), and permits the simultaneous discharge of several cars into the same receiving tank (9).

Siphon discharger for acid tank cars

(1) Tank car; (2) auxiliary vessel; (3) detachable siphon pipe; (4), (7), (8) cocks; (5) supporting structure; (6) pipe; (9) acid receiving tank; (10) centrifugal pump



If v is the volume of pipe (3) in cu. ft., h is the level difference in ft. and d is the density of the acid relative to water, then the volume V of the auxiliary vessel (2) that is theoretically required, expressed in cu.ft., may be stated as:

$$V = v/(1 - 0.0328\,hd)$$

In practice the volume so calculated should be multiplied by 5 or 6 as a factor of safety. For example, if pipe (3) is of 2 in. size, 20 ft. long, and if $h = 10$ ft., then v = about 0.4 cu.ft., d for 50 deg. Bé. sulphuric acid = 1.52 and V is theoretically about 0.8 cu.ft. Actually this should be increased to 4 to 5 cu.ft.

HIGH PRESSURE PROCESS FOR GUAYULE SEPARATION

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IN THE conventional process for recovering rubber from the guayule shrub, the basic pebble milling operation is followed by a flotation of the milled slurry in which finely divided plant fiber sinks and is separated from floating rubber. Accompanying the floating rubber, however, are particles of cork which must be removed. Standard procedure for removal has been an 80-min. batch pressure treatment at 250 psi. and 200 deg. F. in pressure vessels holding 700 to 900 gal., followed by reflotation of the rubber. This batch treatment in an otherwise continuous milling process produces surges which conspicuously reduce the efficiency of the steps that follow.

Hydrostatic pressures of 1,500 psi. were found to waterlog the cork particles in 10

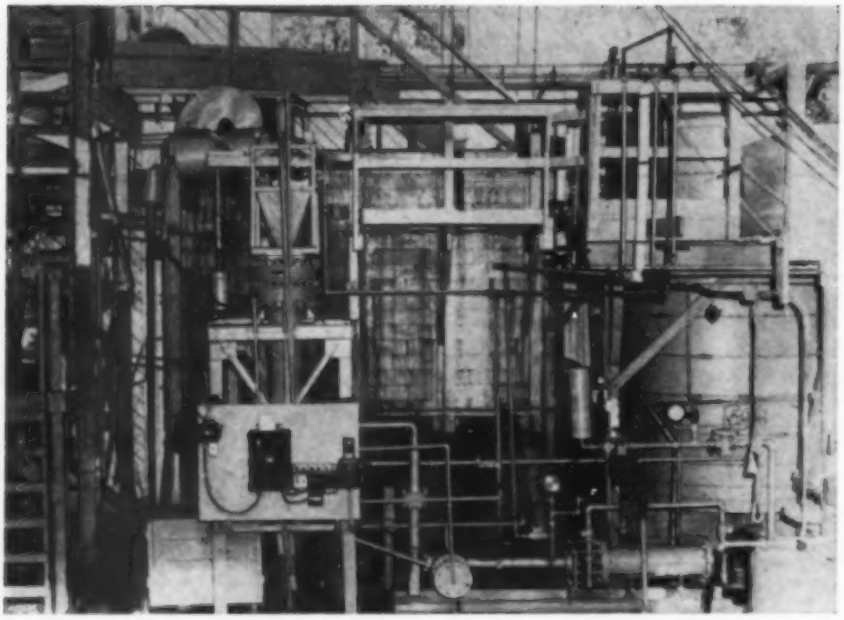


Fig. 1—General view of high-pressure waterlogging equipment

to 15 seconds. This suggested rapid automatic treatment of small batches to obtain an essentially continuous flow.

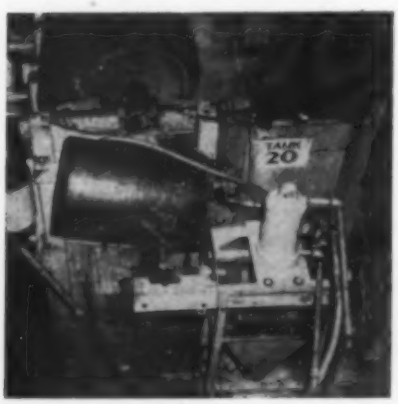
To assure dependable and continuous operation, any equipment for such treatment must cope with the tendency of rubber coagula to mat and to cling to metal surfaces; ports must be large to pass chance lumps, and valves must be washed completely free of rubber particles and dirt at every closure. Consideration of flow continuity and equipment cost favored a small pressure chamber. All these requirements necessitated special equipment.

The automatic unit developed utilizes for operation water at 70 psi. As shown in the diagram and the two views it consists essentially of:

1. A large feed tank (1) maintained at 200 deg. F. and at constant water level and equipped with a scoop that delivers to the metering bucket at each revolution about 7½ gal. of the water suspension of rubber and cork particles.

2. A 21-gal. hydraulically operated metering bucket (2) equipped with an overflow to give a precise volume of charge, and an agitator to disperse lumps.

Fig. 2—Automatic metering bucket dumping into hopper



3. A 23-gal. 10-in. diameter high pressure chamber (3) made of a flanged cylinder cast of alloy iron. The cylinder is headed on each end by a companion flange having a 5-in. diameter center hole which is beveled and faced with No. 6 Stellite backed by No. 1 Stellite on the inner edge to form a valve seat. Valves, also Stellite faced as shown in Fig. 4, are internal and hydraulically operated. These closures are critical points in the unit; they must be opened and closed continuously without leaking at 2,000 psi.

4. A hot water spray (4), timed to cleanse the top valve during closure and metered to fill the chamber below the rising valve to minimize the air pocket.

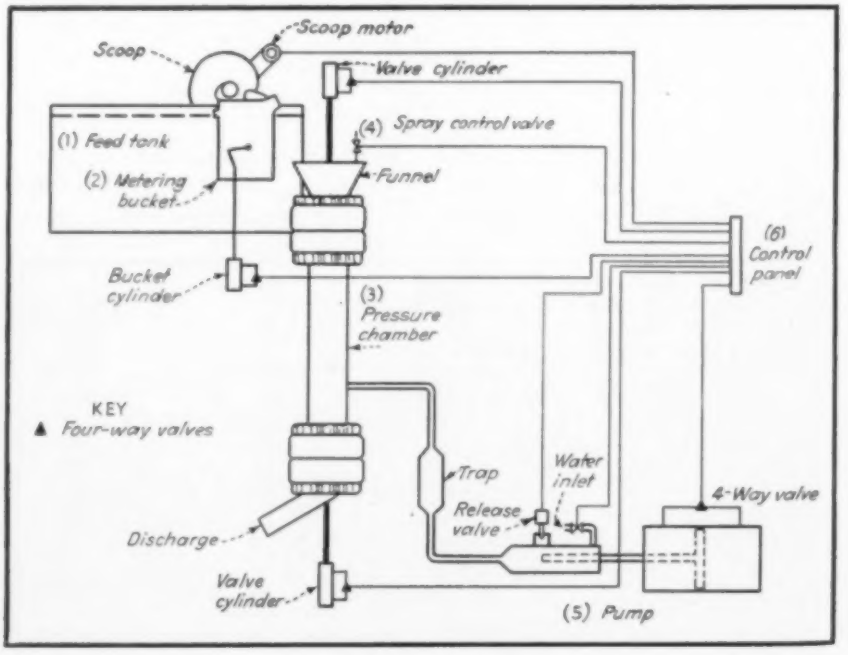
5. A hydraulic pump (5), with a 2-in. diameter piston, designed to convert 70 psi. in the water supply main to 2,000 psi. in the chamber. This piston works in high pressure piping connected through a trap to the 10-in. cylinder near its bottom. The piping is fitted with a pressure release valve and a safety valve, and is connected through check and solenoid valves to the water main.

6. A seven-cam electrical timer (6) operating through interlocking switches and solenoid valves to control the sequence and duration of all steps.

When the unit is in operation, the scoop on the feed tank (1) makes three revolutions to fill the metering bucket (2) to overflowing. The scoop then stops. With the top valve of chamber (3) open, the metering bucket pours in the well dispersed charge, and on returning to filling position starts the scoop. Then the top valve closes, as spray (4) flushes the seats and fills the chamber to the level of the rising valve. With both valves closed, internal pressure is raised to 70 psi. by admitting water through the check valve. The 2,000 psi. pressure is then created and maintained for 20 seconds by driving the 2-in. diameter piston of pump (5) into the system. Pressure is then reduced to 70 psi. by withdrawing the piston, and to atmospheric pressure by opening the release valve. For unloading the chamber, the bottom valve is opened first, so that inrushing air will cause turbulence in the charge; the top valve is timed to open near the end of dumping. With the chamber empty and both valves open, remaining rubber is then flushed out by the top spray and by water introduced through the high pressure piping. Flushing through this piping insures that the piston operates always in clean water free of rubber particles and dirt. The bottom valve closes with water continuing to flush the seat.

As the cycle ends, the high pressure piping is full of clean water, the meter-

Fig. 3—Diagram of equipment for semi-continuous waterlogging treatment



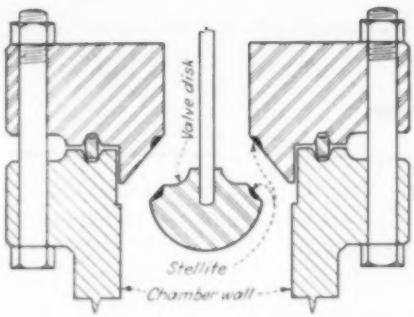


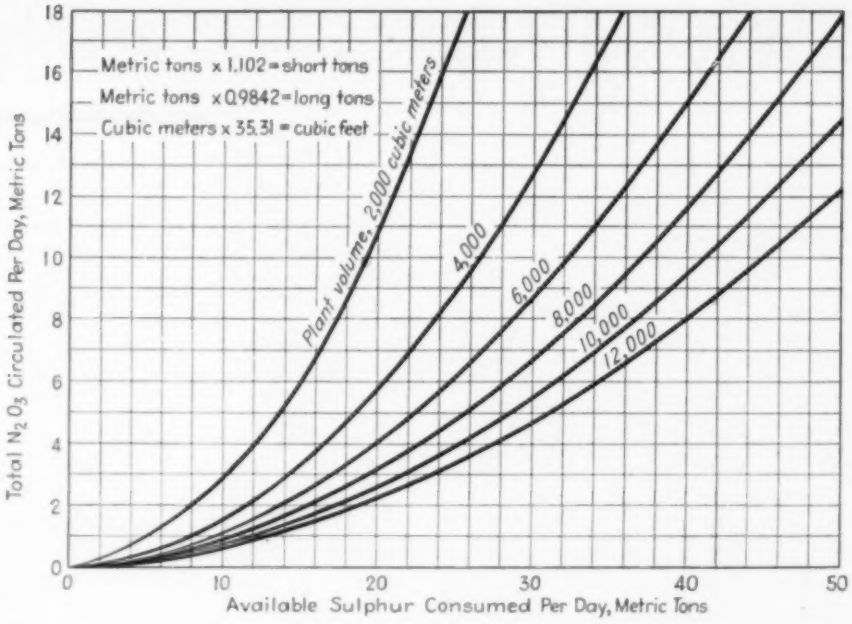
Fig. 4—Detail of valve for high-pressure chamber

ing bucket is full to the overflow lip, and the agitator in the bucket is running to disperse any chance lumps.

It should be noted that the charges must be of precise volume but may contain from 0 to 1¾ lb. of rubber per gallon, and that matting of rubber coagula is overcome by agitation in the metering bucket and turbulence in the chamber during unloading. Internal surfaces are flushed between charges, and the plunger operates only in clean water.

All steps in the cycle are controlled by a timer with certain steps connected by interlocking switches to insure the attainment of 2,000 psi. pressure in each cycle. The timer can be set to make from 1 to 30 two-minute cycles per hour, but since the concentration of rubber per charge can vary from 0 to 37 lb., no timer adjustments are required for temporary variations in rubber production.

The termination of the Guayule Emergency Rubber Project precluded the installation of this continuous unit in the Project's plant at Salinas as planned, and its operation under production conditions. Performance tests and daily 8-hour pilot plant operation through a period of 4½ months were, however, most successful. No difficulties were encountered with the high pressure pump, the chamber or its valves. Three brief interruptions to operation were due to trouble with a standard check valve, a solenoid coil, and a valve diaphragm.



Relation between total nitrogen trioxide in circulation, total plant volume and available sulphur consumption in a nitration process sulphuric acid plant

DETERMINING NITER SUPPLY IN SULPHURIC ACID PLANTS

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ANY GIVEN sulphuric acid plant of a type operating on the chamber principle can be run at various rates of capacity, depending on the capacity of the burners to produce SO_2, the capacity of the towers, chambers and fans, and the will of the operator. This is true whether the plant is of the tower or chamber type. Once the operating rate is decided upon, that is, the reaction speed, it becomes necessary to adjust the proportions of niter and SO_2 accordingly, with due regard to efficient recovery of the niter.

An operating rate above normal is quite possible in a chamber plant, provided the total niter in circulation is also above normal. Since 10 to 15 percent of the latter is lost in process and must be replaced as fresh or primary niter, proper adjustment of the total niter supply is of great importance.

A simple solution to this problem is given in the accompanying chart which represents the relation between the available sulphur actually entering into reaction and the total niter in circulation.

The main criterion for any plant is its total free volume. So far as niter in circulation is concerned it is immaterial whether this volume is in chambers and towers, as in conventional chamber plants, or in towers alone as in special plants.

The chart is based on the expression:

$$N = S/42 + (S^2 \times 53.4)/V$$

where N is the total niter circulated in a 24-hr. day, expressed in metric tons of N_2O_3, S is the available sulphur in metric tons per day, and V is the total free volume of the plant in cubic meters.

Example—A plant with a capacity of 153 metric tons per day of 60 deg. Bé. acid has a total free volume of 10,000 cu. m., including Glover tower, chambers and Gay Lussac towers. If the yield is 3.83 kg. of 60 deg. acid per kilogram of available sulphur, then 153 metric tons of acid will require 40 metric tons of available sulphur. The above formula, calculated from these data, becomes $N = 40/42 + (40^2 \times 53.4)/10{,}000 = 9.51$ metric tons of N_2O_3. The chart gives the same result.

Any Welder Can Make This Drum Handling Attachment

Operators of fork trucks handling heavy drums of oils or chemicals can accomplish more with the simple home-made device shown here. Without getting out of his seat the operator picks up, carries and stacks the drum. The lift plate carries short knife-edge fork blades that slip readily beneath the drum. A retaining hoop is then lowered over the drum top by a foot operated lever. Release of the drum on top of the stack is simply the reverse of the pick-up operations (Photos courtesy of Yale & Towne Mfg. Co., Philadelphia Div.)

PROCESS EQUIPMENT NEWS

THEODORE R. OLIVE, Associate Editor

INCLINED KILN

NEW PRINCIPLES in the design of kilns for calcining lime and other metallic and non-metallic minerals are found in the No. 5 inclined furnace recently developed by Victor J. Nelson Engineering & Construction Co., 1321 Riverside Drive, Burbank, Calif. Kilns of this type have been installed in Mexico and at Provo, Utah. The most novel feature of the kiln is that it is installed either on a hillside, or on structural supports, at an angle of about 35 deg. with the horizontal. It consists of a refractory chamber, fed by gravity at the upper end, discharging by means of a simple mechanical discharger at the lower end. The only moving parts include the discharger and a "stoking rod," both driven by the same 1-hp. motor, and an induced draft blower, also requiring 1 hp. It is claimed that the furnace handles about 30 tons per day input, requires only about 4½ bbl. of a crude oil fuel per 24 hr. day, reduces the stack gases to only about 200 deg. F. and yet is capable of operating efficiently at furnace temperatures up to 3,400 deg. F. Maintenance is said to be slight and power for operation almost negligible. Cooling of the product and preheating of the combustion air are accomplished by counterflow of air and product at the discharge end.

SLURRY PUMP

PUTTING the suction connection on the shaft side of an over-hung centrifugal pump rotor is the novel accomplishment of Morris Machine Works, Baldwinsville, N. Y., in the new Type R slurry pump. This new feature puts the packing gland under suction pressure only and is said to result in freedom from packing troubles and to overcome the uncertainty of hub-sealing water pressures. Maximum suction lifts are thus said to be possible, as well as practically unlimited positive suction heads.

Designed for handling sludges, silts and all types of caustic or acid mixtures containing abrasives or solids, as well as residues from filters and classifiers, the pump features ready dismantling (with the removal of only four bolts); large hydraulic passages; a balanced-pressure type of impeller; and a simple means of adjusting impeller clearance after wear.

AUTOMATIC CLUTCH

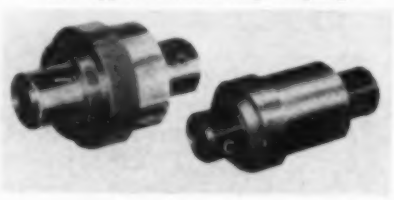
ANNOUNCEMENT of the development of a new automatic clutch which is said to disengage instantly upon overload and so prevent damage to automatic machinery has been made by Polaroid Corp., Cambridge 39, Mass. The clutch, developed by O. E. Wolff, senior engineer of the corporation, employes the automatic introduction of a lubricant between the frictional surfaces to bring about complete disengagement the instant one of the parts is overloaded. The clutch is produced in several different forms. In one type a cylindrical shell attached to a hub incloses another hub containing multiple shoes mounted in such a way as to bear against the internal surface of the shell under controllable pressure. A lubricant within the shell forms a film instantly between the shoes and shell when the transmitted torque becomes excessive since the shoes are free to tip lightly. This produces substantially complete disengagement of the clutch. However, if both shafts are brought to rest or to the same speed, the fluid film is broken and the clutch re-engages.

In another type, adaptable to flexible coupling use, the shoes are molded from neoprene or similar material and expanded by spring loading against the shell. Overloading again causes the lubricating film to form and the clutch to slip.

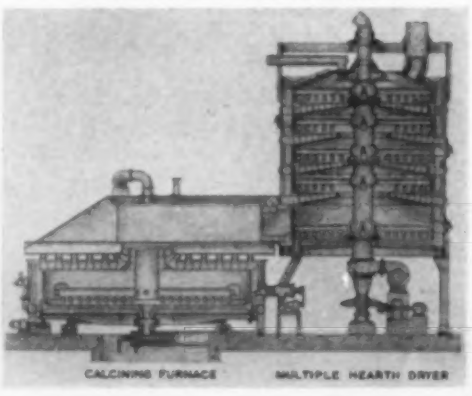
LIME MUD CALCINER

EQUIPMENT developed especially for the reburning of lime mud produced in various chemical processes and in the paper industry is being offered under the name of the Martin calcining process by Morse Boulger Destructor Co., 205 East 42nd St., New York, N. Y. The process is designed especially to eliminate lime dust and produce a good soft-burned lime, with high efficiency. For this purpose, the equipment consists of a dryer of the multiple hearth type which serves to preheat the lime mud and deliver it to a calcining furnace in the form of small soft pellets of $CaCO_3$ at a temperature of 1,400-1,600 deg. F. The hot material discharged from the dryer passes through a roll type pulverizer to insure a more uniform burn and to eliminate pulverizing and additional handling after calcining. The calcining furnace, as shown in the accompanying view, is of the rotary hearth type, containing six stationary rabble arms, three carrying plows that move the material toward the center discharge, the other three moving the material to a lesser extent toward the periphery, thus controlling holding time and contributing extra agitation to the bed. This furnace is fired by means of six tangential burners, producing a furnace temperature of 2,000 to 2,200 deg. F. The burned lime discharges at the center at about 1,950 deg. F. while the hot gases pass upward into the multiple hearth dryer, eventually leaving the dryer reduced in temperature to about 350 deg. F. Two or more calcining units may

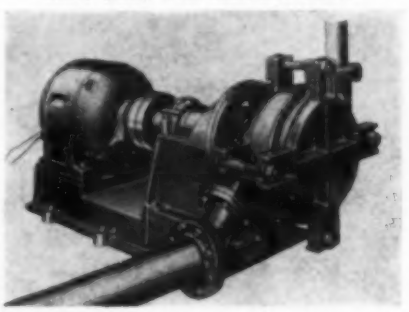
Two types of Wolff slip coupling



Cross section of lime recalciner



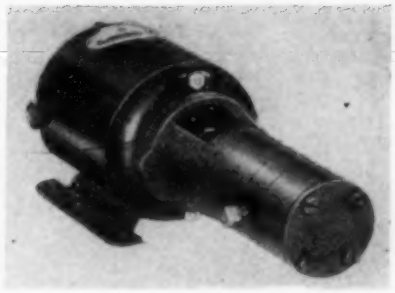
Slurry pump with shaft-side suction



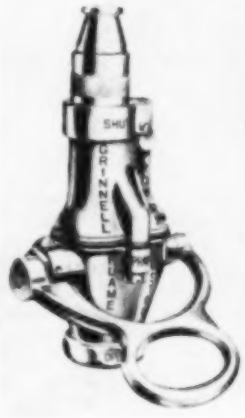
X-ray photometer in use

Koroseal work and acid suit

Unloader pushing bags into freight car



Vane-type rotary pump



Nozzle for both Class A and Class B fires

Radiant Heating Applied to Factory

The new Kankakee works of A. O. Smith Corp., Milwaukee, Wis., is being equipped with radiant heating in what is believed to be the largest such installation on record. The heating system includes 40 mi. of piping in which 15,000 gal. of water is circulated 12 times per hour, or a total circulation of 180,000 g.p.h. Heat is furnished by 120 Smithway-Burkay volume water heaters operating on natural gas, the heaters being manufactured by Burkay Co. of Toledo and distributed by A. O. Smith Corp. The total floor space of the plant is 415,188 sq. ft. Piping of wrought iron, copper and steel is used in a variety of sizes. All radiant piping is installed in the floors which are then surfaced with reinforced concrete.

be combined with a single dryer to permit shutdown of any of the units without affecting operation of the others.

NEW INSTRUMENTS

Several new instruments for measurment and analysis have recently been announced by the Apparatus Department of General Electric Co., Schenectady, N. Y. Included are a new thermal gas analyzer, a new dewpoint recorder and a new X-ray photometer.

The thermal gas analyzer, designated as Type TB, is intended for continuous recording or indicating of the concentration of one component in a mixture of gases whose characteristics can be detected by the thermal conductivity principle. For example, it can be used to detect impurities in hydrogen, carbon dioxide, sulphur dioxide or various organic vapors provided sufficient difference in thermal conductivity exists. The gas analysis is registered on any standard indicating or recording instrument which can be equipped with contacts for closing an alarm or controlling circuits of valves or motors in order to maintain gas concentrations within desired limits.

The dewpoint recorder is a continuous automatic instrument which measures the quantity of moisture in a gas by the refrigerated mirror method. The test gas enters a chamber where it comes in contact with a mirror. A refrigerator or heater cools or heats the mirror until a temperature is attained at which moisture in the gas forms dew on the mirror. A photoelectric eye watches the mirror continuously and the mirror temperature is recorded on a chart the moment dew forms. Thus a continuous dewpoint temperature reading within a tolerance of 2 deg. is obtained.

The X-ray photometer is an analysis instrument for indicating and recording the concentration of one chemical element in the presence of others. The instrument is non-destructive to most materials and analyzes by measuring the change in absorption of X-rays between a sample and a standard. It can be used in measuring ash content of coal, sulphur content of oil, hydrocarbon, chlorine, or fluorine content of plastics, and for other analyses.

ACID SUIT

Resistance to abrasion and to practically all solvents and acids is claimed for the new Koroseal work and acid suit which has been added to its line of industrial clothing by the B. F. Goodrich Co., Akron, Ohio. The clothing is made of best quality textile sheeting coated black with Koroseal and designed for maximum lightness and toughness. Jackets and pants are furnished separately or as a unit. The jacket has a fly front with concealed ball and socket fasteners, strapped arm holes and seams and stand-up collar. Pants are of the bib type with adjustable shoulder straps in the back.

COMBINATION NOZZLE

Use on either oil fires, or those in wood, paper, trash and similar materials, is possible with the FlameBuster three-purpose, portable nozzle made by Grinnel Co., Providence 1, R. I. Approved for both Class A and B fires, this nozzle is said to produce droplets of the correct size, driven at the correct velocity, to form water-carrying emulsions at the surface of burning oil. Where finer droplets at lower velocities are required for extinguishing fires in the lighter oils a low-velocity tip, interchangeable with the usual high-velocity spray tip, is available. Substantially straight passages through the nozzle assure low friction loss while large water orifices minimize the possibility of clogging. Movement of the handle immediately gives the operator of the nozzle a solid stream if necessary for Class A extinguishment at a distance.

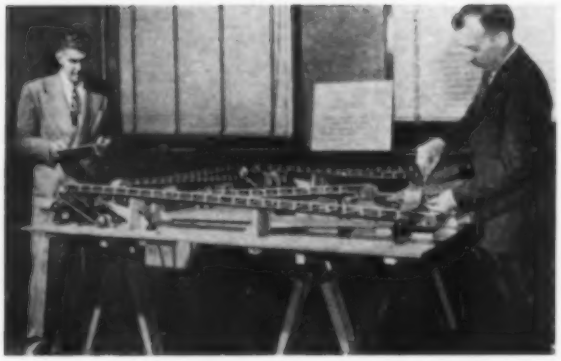
FORK TRUCK UNLOADER

All sizes of this company's Towmotor lift trucks can be provided with a new unloader designed by Towmotor Corp., 1226 East 152nd St., Cleveland 10, Ohio. It is claimed that cost reductions of as much as 50 percent in the loading phase of materials handling can be accomplished through the use of this device, particularly in the loading of box cars. As appears in the accompanying illustration, the unloader is hydraulically operated, two double-acting hydraulic cylinders moving the vertical rack forward in such a way as to push the load off the forks. Since the rack can also pull, it can sometimes be used to pull loads into the forks.

It is reported that a glass container plant using this device worked out a system making it possible to load 94 percent of a box car automatically. A fertilizer plant using similar equipment loaded a 40 ton box car in 28½ minutes, thus reducing loading costs from 50 to 20 cents per ton.

VANE TYPE PUMP

Positive pressure in the handling of non-lubricating liquids such as water is available in a new vane-type pump designated as Model VW-1 and produced by the Eastern Engineering Co., New Haven, Conn. The pump employs two com-

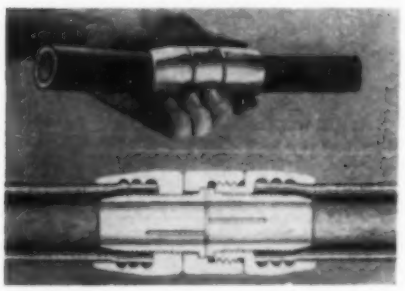


Two-Way Conveyor Belt

What is said to be a new principle of conveyor belt design is illustrated here in four miniature two-way belt conveyors installed in such a manner that each belt carries material both on the "going" and on the "return" runs. The design is that of C. F. Smith (left) of the belt engineering sales department of the Goodyear Tire & Rubber Co., Akron, Ohio. The arrangement is said to be useful wherever a raw material is to be hauled in and a waste material or bulk finished product hauled out of a plant department.

Flow-diversion diaphragm valve

Portable alloy steel belt conveyor



High pressure hose coupling

position bearings requiring no lubrication, together with vanes made of the same material as the bearings. It is intended for use in systems having a relief valve and therefore has no bypass valve of its own. Shaft sealing is accomplished by a mechanical rotary seal. Delivery approximates 0.5 g.p.m. at operating pressures from 0 to 30 psi. A 1/15 hp. universal motor for 110 or 220 volts is used.

CONTROL VALVES

A NUMBER of new diaphragm valves for automatic control have been developed recently by Hammel-Dahl Co., 243 Richmond St., Providence 3, R. I. One development is a full line of such valves, in sizes of ½ to 1 in., in alloy construction, employing either No. 304 or 316 stainless steel or other special corrosion resisting alloys obtainable in cast form. A unique feature is the use of a single body casting for each size. The company has also developed a full line of diaphragm operated control valves for flow diversion service, which are of the three-way type, the position of the diaphragm-operated plug valve determining the diversion of flow between the two outlet ports from zero to 100 percent flow. These valves are produced in sizes from ¼ to 6 in. inclusive, in cast iron, steel, bronze or stainless steel.

PERCENTAGE TIMER

TYPE PE is the designation of a new percentage timer offered by the R. W. Cramer Co., Centerbrook, Conn. The device is one of a number of electrical control devices made by this company and is said to have a wide variety of industrial applications in automatically controlling the percentage of time during which any electrical circuit is closed or opened out of a definite length of time. For example, the device may be used in the time percentage regulation of current input to electric ovens and furnaces or in regulating the proportional flow of materials into or out of processes. Graduations may be in percentages of time or directly translated to feet per minute, gallons per hour, degrees of temperature, etc. Such timers, intended for use on alternating current, are said to repeat within 0.25 percent of any given setting and to be rated for continuous service.

LIGHT WEIGHT CONVEYOR

WEIGHING only 135 lb. (without the motor) in the 12 ft. model, the new light weight portable Tote-All Zephyr conveyor has been announced by the Material Movement Industries, 310 South Michigan Ave., Chicago 4, Ill. The conveyor is made of special alloy steel which is corrosion and abrasion resistant and is available in 12 and 16 ft. lengths, both provided with an 8 in. belt. Power is furnished by a gasoline engine mounted above the conveyor or by an electric motor, if desired. The conveyor is said to be suitable for handling all kinds of bulk products such as salt, fertilizer and coal.

HOSE COUPLING

WORKING PRESSURES of 1,000 psi. or more are possible with a new streamlined hose coupling, said to be smaller and lighter in weight than any heretofore in use, that has been announced by Bar-Way Mfg. Co., Stamford, Conn. Intended primarily for fire fighting, spraying and diving applications, the coupling is also expected to find wide application in the oil industry and in a variety of uses in chemical plants. Production at present is in ½, ¾ and 1½ in. sizes, while ¼, ⅜ and 1 in. sizes will be available shortly. The full diameter of the hose is maintained throughout the connection, without reduced flow or shrinkage of the hose itself. Made of bronze castings, the streamlined design eliminates obstructing projections and dangerous sharp edges.

COMPOUNDING EQUIPMENT

A NEW SERVICE in the design of "push-button" compounding systems for the feeding of any number of ingredients automatically, in any desired sequence and at any predetermined intervals, to Banburies or other mixers, has been announced by Proportioneers, Inc., 29 Codding St., Providence 1, R.I. Materials may be either dry or liquid, thus enabling manufacturers of synthetic rubber, plastics, linoleum, paint and other compounded products to speed up processes, reduce operating expenses and materials handling costs. The company's loss-in-weight control, together with its Adjust-O-Feeder motor-driven metering pump are employed in various combinations to enable the equipment to handle any kind of batch and duplicate exactly previous batches.

BELLOWS METER

AS AN ADDITION to its line of mercury manometer flow meters the Bristol Co., Waterbury 91, Conn., has developed a bellows type differential meter for applications where the mercury type of instrument is not desired. Known as the Bellows-Differential flow meter, the new instrument will be supplied as a mechanical, electrical or as a pneumatic transmission flow meter. Instruments will be available in a complete line of recording, indicating, integrating and automatic control models. The meter body of the new instrument, operating on a new principle, requires no mercury and uses a unique method of transmitting the bellows motion to the pen arm. The new method is said to isolate the meter body shaft completely from the measured fluid.

CONDUCTIVITY RECORDER

TYPE RP is the designation of a new electrolytic conductivity recorder developed by Industrial Instruments, Inc., 17 Pollock Ave., Jersey City 5, N. J., for conductivity measurements by this company's Solubridge method. The new Solubridge recorder employs an a.c. wheatstone bridge circuit operating on the null balance principle. On this account accu-

racy is independent of line voltage variations as well as vacuum tube characteristics. The instrument can be furnished for one, two, three or four continuous line records on the same 12-in. diameter circular chart. A separate amplifier and motor-driven slide wire are used for each recording pen so that no switching devices are necessary. Hence all the pens of a multiple-pen recorder may move at any time or simultaneously. The instrument, which is housed in a sturdy metal cabinet, employs a compact amplifier to step up the wheatstone bridge output voltage and provide electronic control of the slide wire drive motor, both as to direction of rotation and speed. This amplifier is a standard and interchangeable unit. If desired, the recorder can include a 29-in. indicating scale and bold indicating pointer. The instrument is available in types for narrow and wide ranges, suitable for use with electrolytes of either low or high conductivity.

THERMAL PROTECTOR

KNOWN as the Ashcroft Thermal Protector, a device which is essentially a thermocouple-actuated limit switch has been announced by Manning, Maxwell, & Moore, Inc., Bridgeport, Conn. It is intended primarily for protection of equipment of various sorts against over-temperature. For example, it may be desired to protect the air ducts in an oven or dryer, the wheel of a large blower or the bearings of a large motor. The temperature chosen as the high limit is set by an operating knob located inside the case of the instrument where it cannot be tampered with. If this temperature is reached, the device will stop the apparatus before excessive damage is done, or it can be arranged to sound an alarm or light a light. Furthermore, in case the power supply should fail or the thermocouple burn off or break, the device will shut the operation down for safety. The cause of shutdown must be corrected before the device will permit the operation to be resumed. Two ranges are provided, 100 deg. to 1,000 deg. F., and 800 deg. to 2,000 deg. F. If desired, two or more couples may be connected in series. The cold junction is located in the unit and is compensated for ambient temperatures.

HIGH VACUUM VALVE

SIZES of $\frac{1}{8}$ and $\frac{1}{4}$ in. are at present available in a new line of solenoid valves for high vacuum equipment recently announced by Distillation Products, Inc., 755 Ridge Road West, Rochester 13, N. Y. The new valves are intended primarily for use where the time necessary for valve opening and closing plays an important part in the process. These valves are normally open, closing instantly when current is applied to the electromagnet.

THERMOSTATIC CONTROL

LOW COST is a feature of the new remote-bulb type thermostat introduced under the designation of Type O by United Electric Control Co., Boston 27, Mass. The unit is intended primarily for industrial applications requiring accurate temperature control in connection with any liquid or gas that is non-injurious to brass, platable metals or stainless steel. Control is based on a snap-action switch actuated by a solidly liquid-filled copper thermal system. Adjustment may be made either by a knob and pointer on a calibrated dial, or by means of a screwdriver. Calibrations may cover any 120 deg. or 250 deg. F. in the range from −120 to +600 deg. F. Screwdriver adjustments cover a somewhat different range. Four bulb types are available to fit all types of installations.

TWO-TON HOIST

A MODEL with a capacity of 2 tons has now been added to the Midget King line of electric hoists manufactured by the Yale & Towne Mfg. Co., 4530 Tacony St., Philadelphia 24, Pa. Hoists previously included in this line were made in sizes from $\frac{1}{8}$ to 1 ton capacity. The new hoist is light in weight and compact, but is equipped with a 1 hp. motor. Lifting and lowering actions are obtained by a flip of the wrist on the one-hand bar grip control. The hoist operator thus has his other hand free to guide the load. The hoist is provided with upper and lower safety limit stops and a load brake and independent motor brake which operate whether the power is on or off. Alloy steel is used for all critical parts.

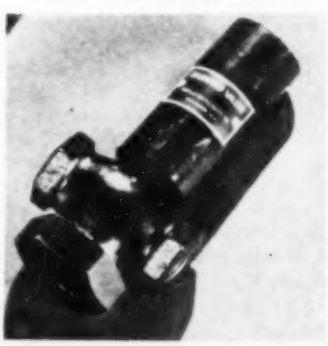
RADIANT BURNER TUBES

RADIANT BURNER TUBES of silicon carbide, which are said to give greatly increased life and more efficient heat transfer, have recently been put on the market by the Gas Machinery Co., Cleveland,

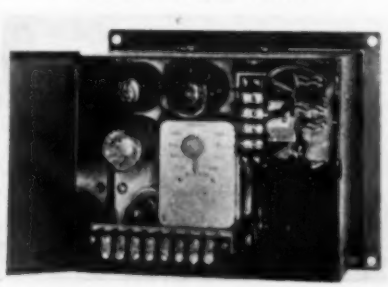
Produces "Nothing" in Large Quantities

This two-stage diffusion pump is one of many produced by the Transportation & Generator Division of Westinghouse Electric Corp. at East Pittsburgh, Pa., for the electromagnetic separation plant at Oak Ridge, Tenn. One of the largest such pumps ever built for extremely high vacuum, it was designed jointly by Westinghouse and the University of California. Smaller pumps of the same type were used in the gaseous diffusion plant. Westinghouse built five different types, containing several combinations and sizes of pumps to produce varying pressures, at different stages of the processes. The pump operates on oil vapor to produce pressures so low that the mean free path of the air molecules in the evacuated space averages 250 in.

Solenoid valve for high vacuum



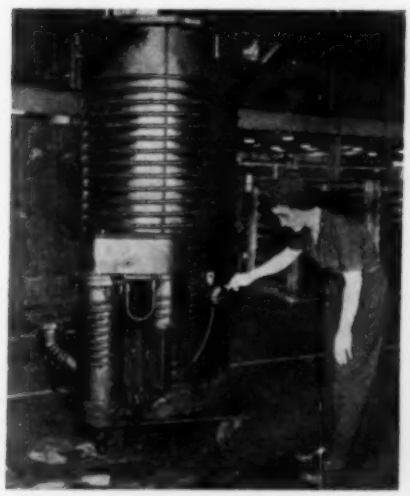
Ashcroft Thermal Protector



Recorder for conductivity measurements

Liquid-filled control thermostat

Right—Midget King hoist



Ohio, in cooperation with the Carborundum Co. These tubes are intended primarily for high temperature controlled-atmosphere furnaces and similar installations where combustion products must be kept from contact with the material in process.

In the past such tubes have generally been made of alloys owing to the difficulty of producing satisfactory joints in the relatively short length of refractory tubes that were available. The new tubes make use of a new tube joint, tube support, and tube loading construction. Instead of the conventional bell and spigot, flange or sleeve joints, the ends of the silicon carbide tube sections are now provided with mating ball and socket surfaces which are ground to a substantially gas-tight fit. The mating surfaces are maintained in contact by spring or counterweight pressure and the several sections of the horizontal tube are supported in cradle-shaped hangers mounted in the furnace wall. As extra assurance against joint leakage, the joints are sealed with a cement which is plastic at the temperature of use.

In addition to the excellent heat transfer properties of silicon carbide, this material appears to catalyze combustoin, permitting exceptionally high combustion rates. This is said to be particularly true at lower operating temperature.

TRANSFORMER-PYROMETER

In one unit the Gyco Pyrotran combines a heavy-duty transformer and a pyrometer, primarily for the control of temperature in heating jackets, but also for use where a variable transformer is required. This device introduced by Scientific Glass Apparatus Co., Bloomfield, N. J., is said to be able to operate at full power for long periods of time without appreciable heat rise. Its principal feature is the method of controlling voltages by two snap-type switches, one for primary adjustment and the other for vernier adjustment. The arrangement eliminates coil type sliding contacts which frequently arc and burn out under load. The instrument includes a Weston pyrometer, built in, to indicate operating temperatures to 400 deg. C, which is calibrated in both Fahrenheit and Centigrade scales for convenient reading.

4,000-lb. fork lift truck

TWO-TON FORK TRUCK

Over-all length has been so carefully limited in the new 4,000-lb. capacity electric fork truck offered by Lewis-Shepard Products, Inc., 222 Walnut St., Watertown 72, Mass., that it is said to be possible to pick up a 48-in. load on a 48-in. fork with the truck, enter an aisle 12 ft. wide, and in one continuous forward movement of the truck make a single right angle turn and right angle stack, without backing or filling. The truck features extremely short turning radius, low center of gravity and small over-all truck length. Maximum maneuverability and stability are thus said to be obtained, together with saving in floor space and consequent reduction in storage building costs.

CONTROL VALVE

Improvements in control valve disk design applicable in valve sizes from ½ to 3 in. have been introduced by H. H. Belfield Co., Broad St. at Hamilton, Philadelphia, Pa. Some years ago the equal percentage characteristic in control valves was recognized as an important type for many control purposes. However, it is said that valves produced with such a characteristic were generally available only in valve sizes of 1 in. and larger. The new valve employs the new Belfield pilot piston, which is a wide-range control disk with an equal percentage characteristic. The design is said to result in positive control action with a rangeability of 50 to 1. The new valve is provided with a diaphragm motor of extreme sensitivity, an oil-temperated high-alloy-steel spring and an extra deep stuffing box with small diameter disk stem to minimize friction.

EQUIPMENT BRIEFS

An improvement over the edition first announced in 1942 is the new Color Harmony Manual now offered by Container Corp. of America, 111 West Washington St., Chicago 2, Ill. The first edition, which contained 680 color chips and was utilized by many chemical, paint and other manufacturers interested in color, has been improved by the development of the new Manual in which the individual color chips are 1 in. square, plus a tab, providing two and one-half times more working area than the chips of the first edition.

Askania Regulator Co., 1603 South Michigan Ave., Chicago 16, Ill., has developed a substitute for goat's skin for flexible diaphragms that is said to be superior to that material. Previous to the war imported skins of first quality were the only ones suitable. Diaphragms made of glass fiber, which is non-porous, does not sag or stretch, and are resistant to alkalis and acids, were this company's answer to the skin shortage.

For the blending or emulsifying of two liquids, Schutte & Koerting Co., 12th and Thompson Sts., Philadelphia, Pa., has introduced a new liquid mixing eductor utilizing the jet principle. The pressure liquid issues from a jet orifice at high velocity and entrains the secondary liquid,

Combination pyrometer and transformer

producing extreme turbulence. Mixers of this type are inexpensive and can be made from almost any material. They may be used for chemical proportioning, water treatment, and similar purposes.

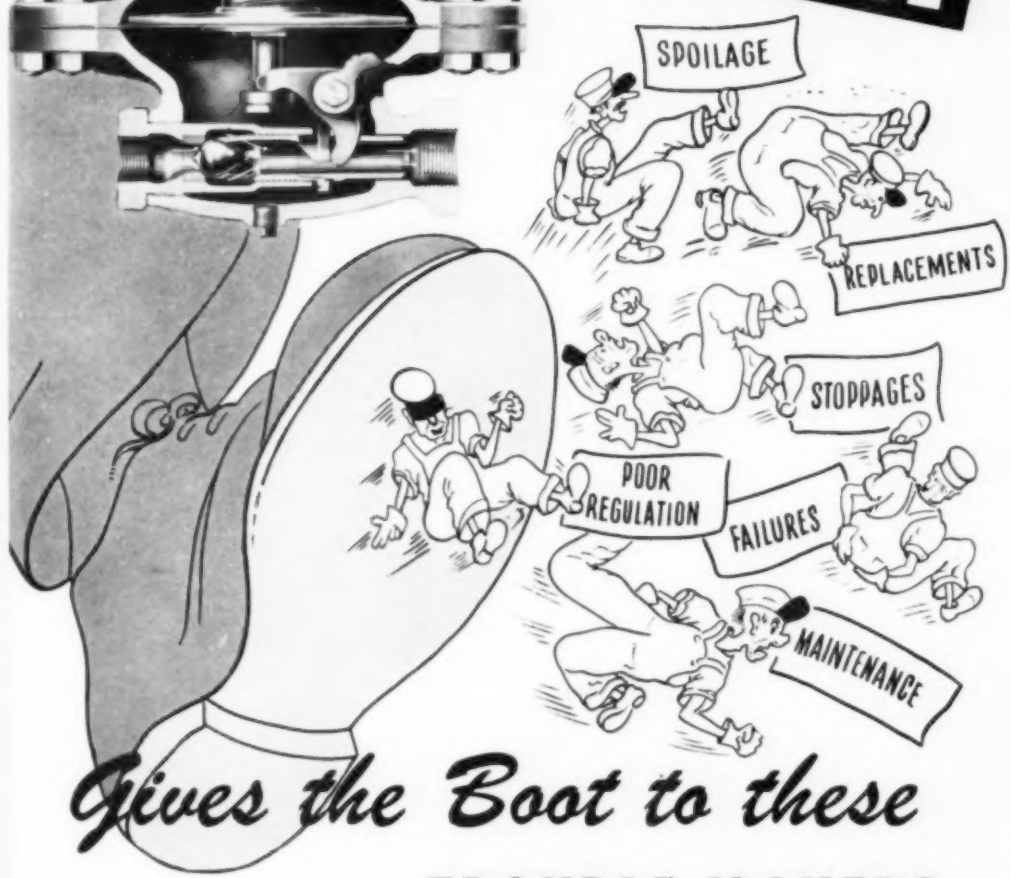
Twindow is the name of a new type double-glazed window insulating unit for industrial and other uses announced by Pittsburgh Plate Glass Co., 632 Duquesne Way, Pittsburgh, Pa. These devices are integral insulating units of two or more panes of glass inclosing a quarter-inch or half-inch hermetically sealed air space. Hollow aluminum tubing is used to separate and hold these glass plates in position, the entire unit being framed with a light gage stainless steel channel. Marked reduction in heat transmission is claimed, together with virtual elimination of window condensation.

Designed for hoisting drum-type containers, the Trylon safety drum sling introduced by Wire & Cable Division of the Wind Turbine Co., West Chester, Pa., is said to make possible the handling of heavy drums, barrels, kegs and similar large containers with both ease and safety. Heavy clips mounted on a rod with an adjustable pressure spring at each end grip the container securely until it is delivered. Spacing of these clips can be quickly altered to fit any size container. The unit is capable of handling any weight of load normally encountered in such containers.

Designers of equipment incorporating linear motion will be interested in the new linear-motion ball bushing introduced by Thomson Industries, Long Island City, N. Y. This company has now developed a round-shaft type ball bushing that makes available the advantages and economies of ball bearings for linear equipment movement.

Aluminum awnings for industrial plants, designed to roll up automatically into a neat compact roll at the top of the window, are now available from Aluminum Awning Co., Division of Orchard Bros., Inc., 421 Meadow Road, Rutherford, N. J. The awnings are non-sagging, non-shrinking and non-stretching according to the maker. A variety of colors can be secured.

CASH STANDARD Streamlined PRESSURE REDUCING VALVE TYPE 1000



Gives the Boot to these

TROUBLE MAKERS

1. Maximum Capacity when needed most
2. Accurate Pressure Control under toughest working conditions
3. Trouble-free Service
4. Smooth Operation
5. Tight Closure
6. Accurate Regulation
7. Speedier Production Results
8. Elimination of Failures
9. Constant Delivery Pressure
10. Cost Saving Operation
11. No Spoilage
12. Practically zero in maintenance costs

These saboteurs in your plant are ticketed for complete disappearance when they get this boot. It's an immediate and profitable result you get thru valve performance when the CASH STANDARD Streamlined "1000" is put on the job. And these trouble makers can stage no comeback.

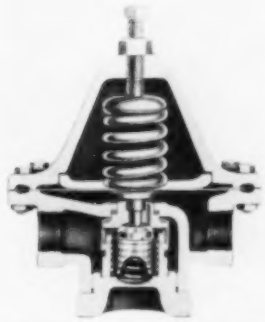
Write for Bulletin "962" — see how you can apply the "1000" to your lines to do that pressure reducing job most dependably and exactly, with good cost savings.

CASH STANDARD CONTROLS.. VALVES

A. W. CASH COMPANY
DECATUR, ILLINOIS

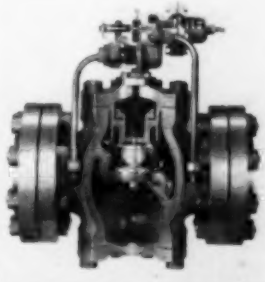
BULLETINS AVAILABLE ON OTHER CASH STANDARD VALVES

Send for them



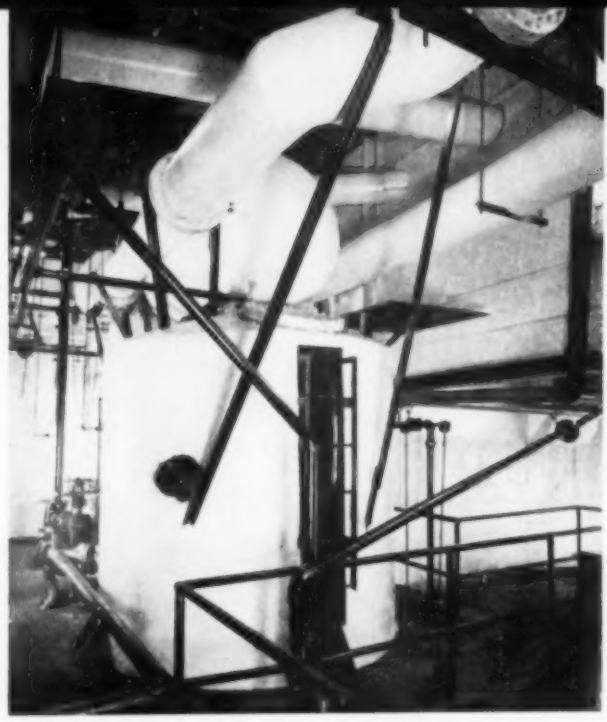
Bulletin 950—features the CASH STANDARD Type D Single Seat Pressure Reducing and Regulating Valves for use with most fluids. Shows simple inner working parts that save in maintenance. Diagram explains how valve works. Blueprint shows simplicity of installation.

Bulletin 956—features the CASH STANDARD Type 4030 Back Pressure Valve — designed to automatically maintain a constant pressure in the evaporator corresponding to a constant temperature desired. Shows an Ammonia and Freon Gas Capacity Chart based on ABSOLUTE pressures.



Bulletin 966—features the CASH STANDARD Self-Contained, Pilot Operated Type 10 Pressure Reducing and Regulating Valve for use with water or air; with any gas or oil that is non-corrosive; and with refrigerating fluids such as Ammonia and Freon. Many interesting particulars explained such as: how valve works, tight seating, large capacity, no waste, no water hammer or chatter.

1A **Heating of the several operations is accomplished by use of Dowtherm vapor**



2A **Batch deodorizer is flexible, therefore useful where stock is varied from batch to batch**

A CHEMICAL ENGINEERING PICTURED FLOWSHEET

DEODORIZING EDIBLE OILS

Deodorizing is the final processing step in a refinery which converts crude animal and vegetable oils into edible products for use as shortening, margarine, salad or cooking oils. The process essentials entail steam stripping of the refined oil to remove almost all traces of free fatty acids and other volatile undesirables. This purification is accomplished at temperatures ranging from 400 to 480 deg. F. and under a high vacuum of about 0.25 in. Hg absolute.

The process may be carried out either continuously or batchwise to produce generally comparable products. However, the continuous method is of a nature to permit dollar savings in steam, water, fuel and labor up to 50 percent of the batch processing costs. On the other hand, the continuous deodorizer is not adapted to quick change-over from one oil to another. To be most effective, a continuous deodorizer should be operated with the same feed stock for extended periods of at least five to seven days. A batch unit is more flexible and can vary its stock from batch to batch.

In the Durkee Famous Foods plant at Elmhurst, L. I., a series of batch deodorizers is employed to process various products such as coconut, soya and cottonseed oils. 15,000 lb. of oil is charged to a kettle, heated, and steam stripped at operating temperature for an extended period, after which the final product is cooled by internal deodorizing coils. Vacuum is maintained by individual 3-stage high-vacuum units. Heating is accomplished through use of condensing Dowtherm vapor with the condensate returned to the vaporizer by means of a centrifugal pump.

The continuous deodorizer shown is one being operated by Armour & Co. at their Jersey City plant. Its nominal rating is 3,000 lb. per hr. of cottonseed oil or vegetable animal compound mixture.

During normal operation of this system, partially heated oil is fed to the top tray of the deaerating section on which air and other volatile materials are released from the oil under full vacuum. The undeodorized oil continuously overflows through a Dowtherm heated sheet and tube unit in which maximum oil temperatures are reached. In the tower, oil on the top stripping tray and lower trays cascades downwards countercurrent to stripping steam rising through the bubble caps so that only fresh steam comes into contact with the finished product.

Oil is pumped from the base of the tower at a regulated rate through the oil to oil heat exchanger and next to storage.

The equipment for both plants illustrated was designed and furnished by Foster Wheeler Corp.

CHEMICAL ENGINEERING

September, 1946

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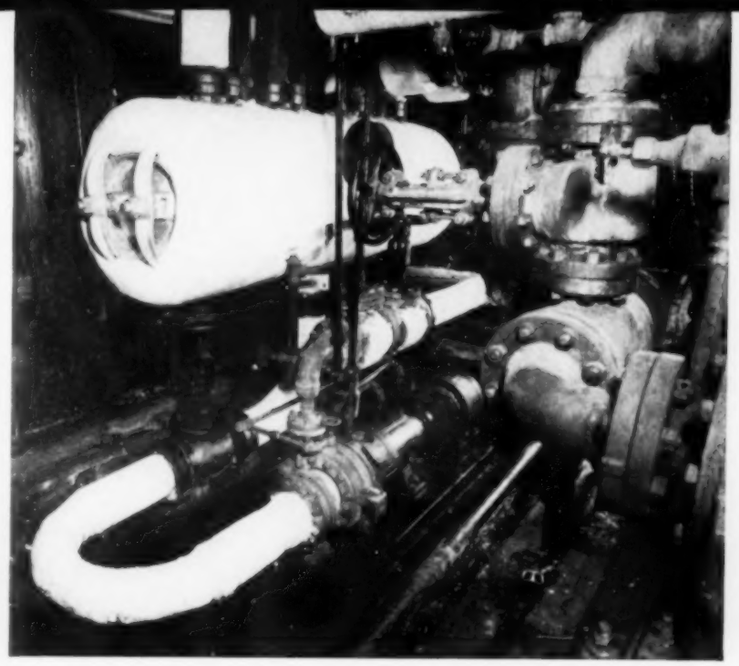
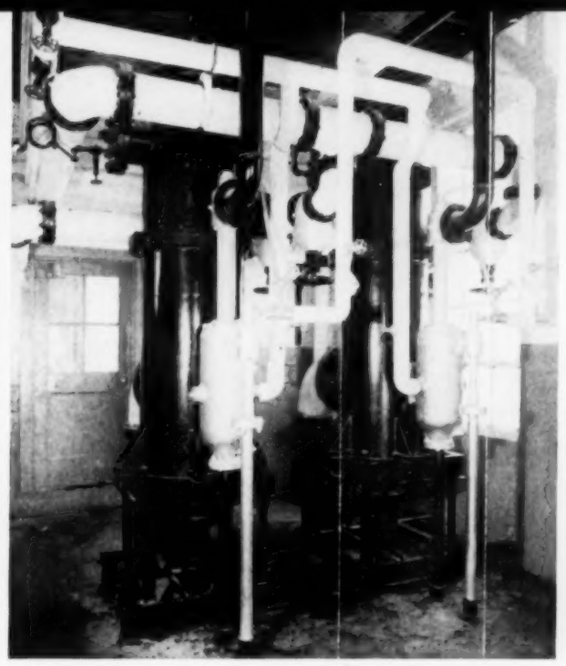
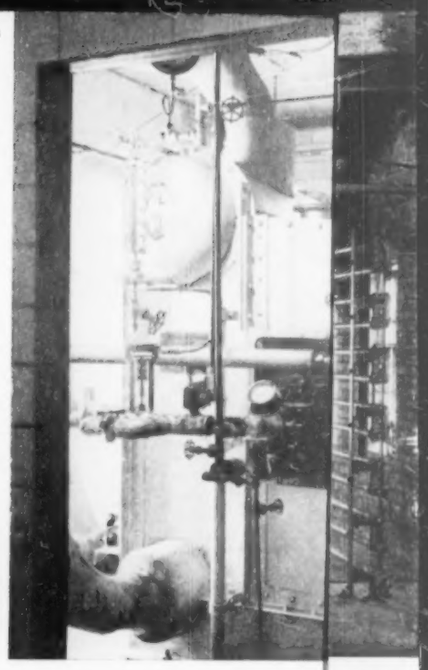


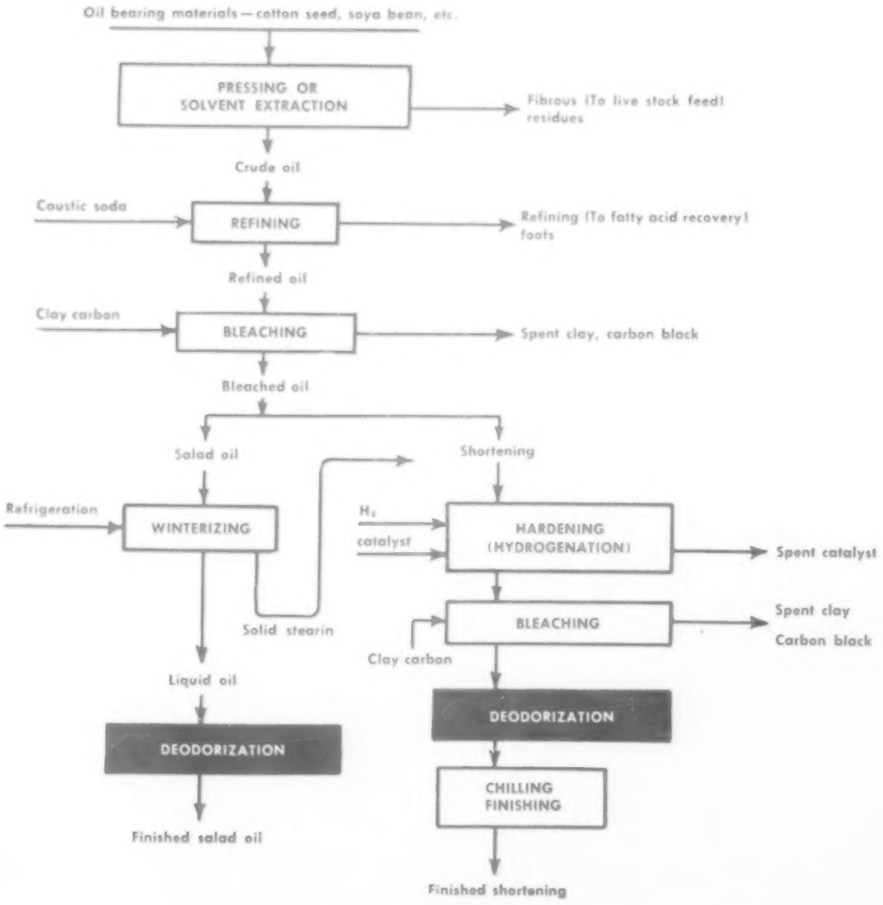
3A Dowtherm condensate goes to the receiver from which it is returned by the centrifugal pump shown here

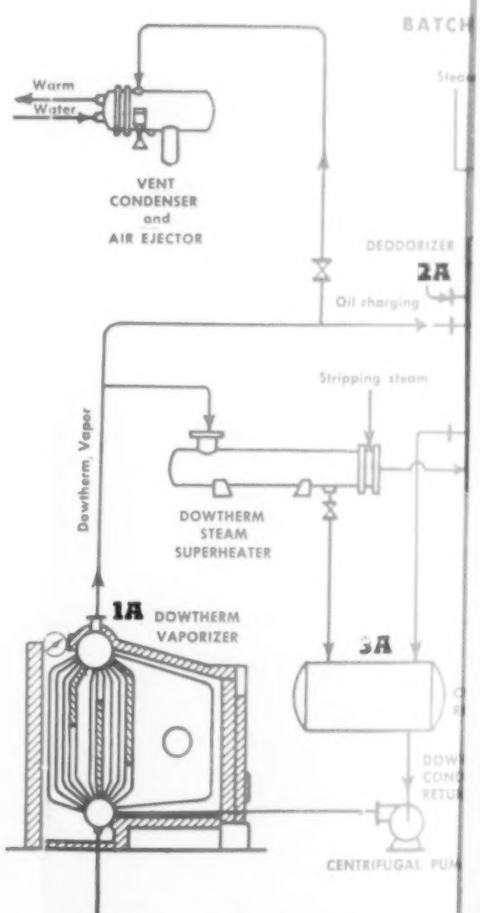


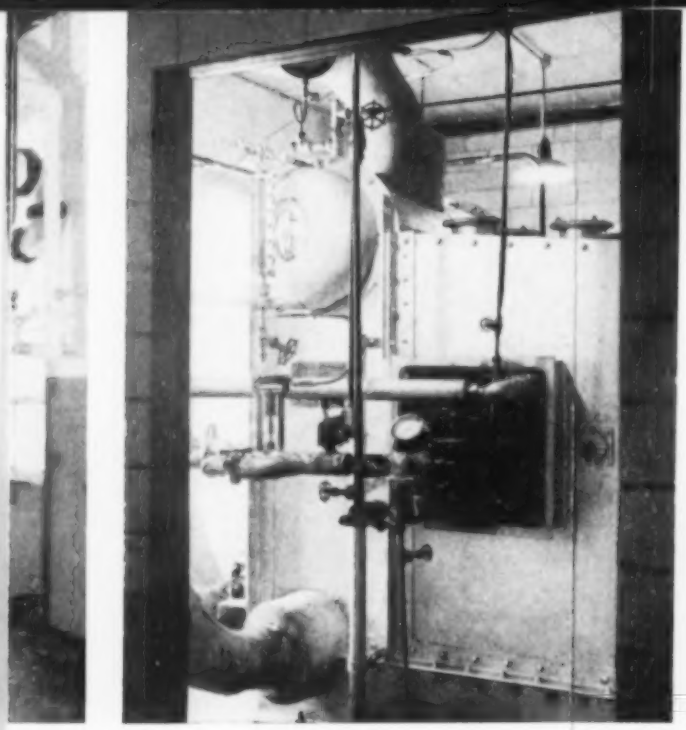
4A Vacuum units, 2nd and 3rd stages, with barometric condensers. Vapor inlet on back of large condenser



1B Dowtherm vapor unit in th (shown dorization plant of Armour & C n to stor







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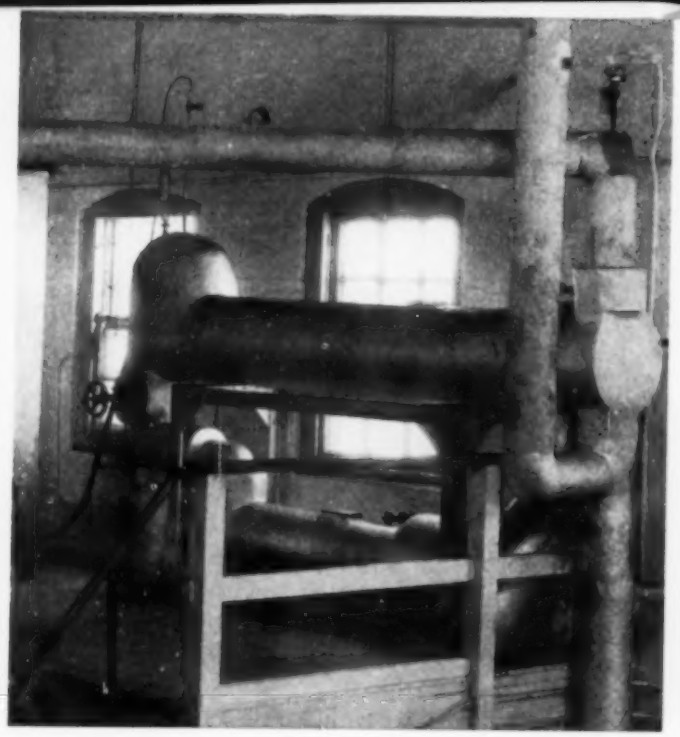
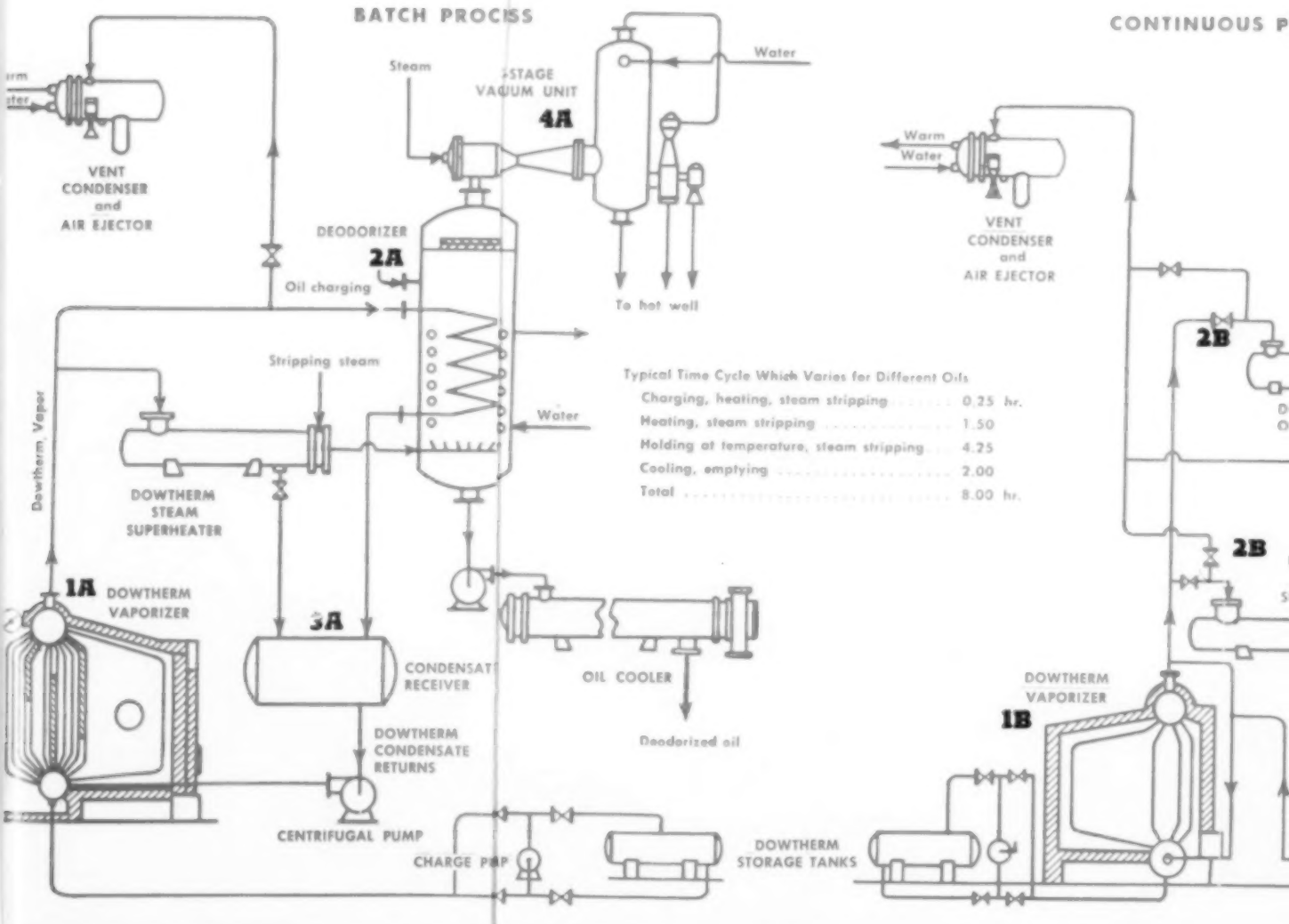
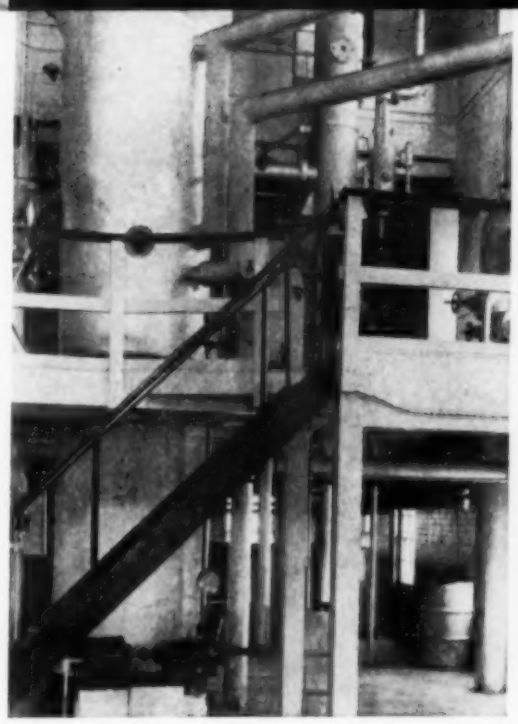
1B Dowtherm vapor unit in the continuous deodorization plant of Armour & Co. at Jesey City



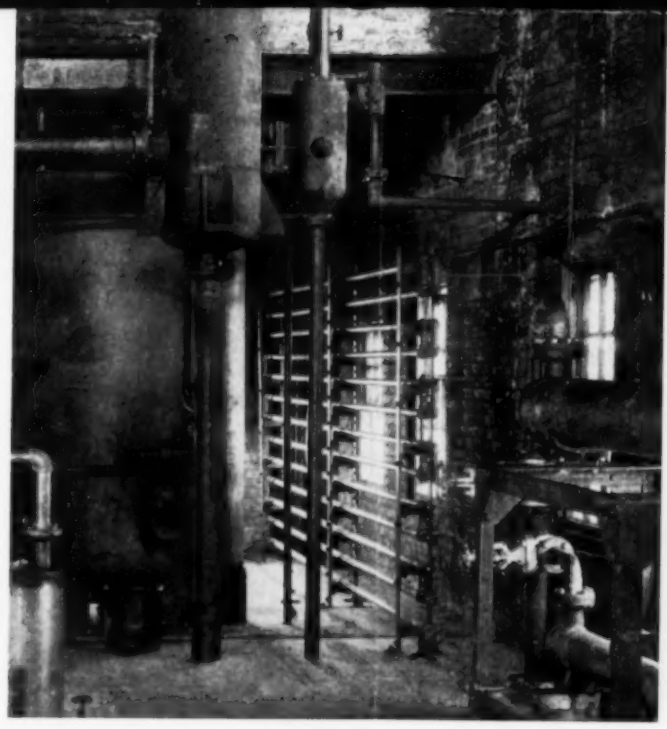
2B Above is Dowtherm line to oil preheater and below Dowtherm line to steam superheater

3B
oil is

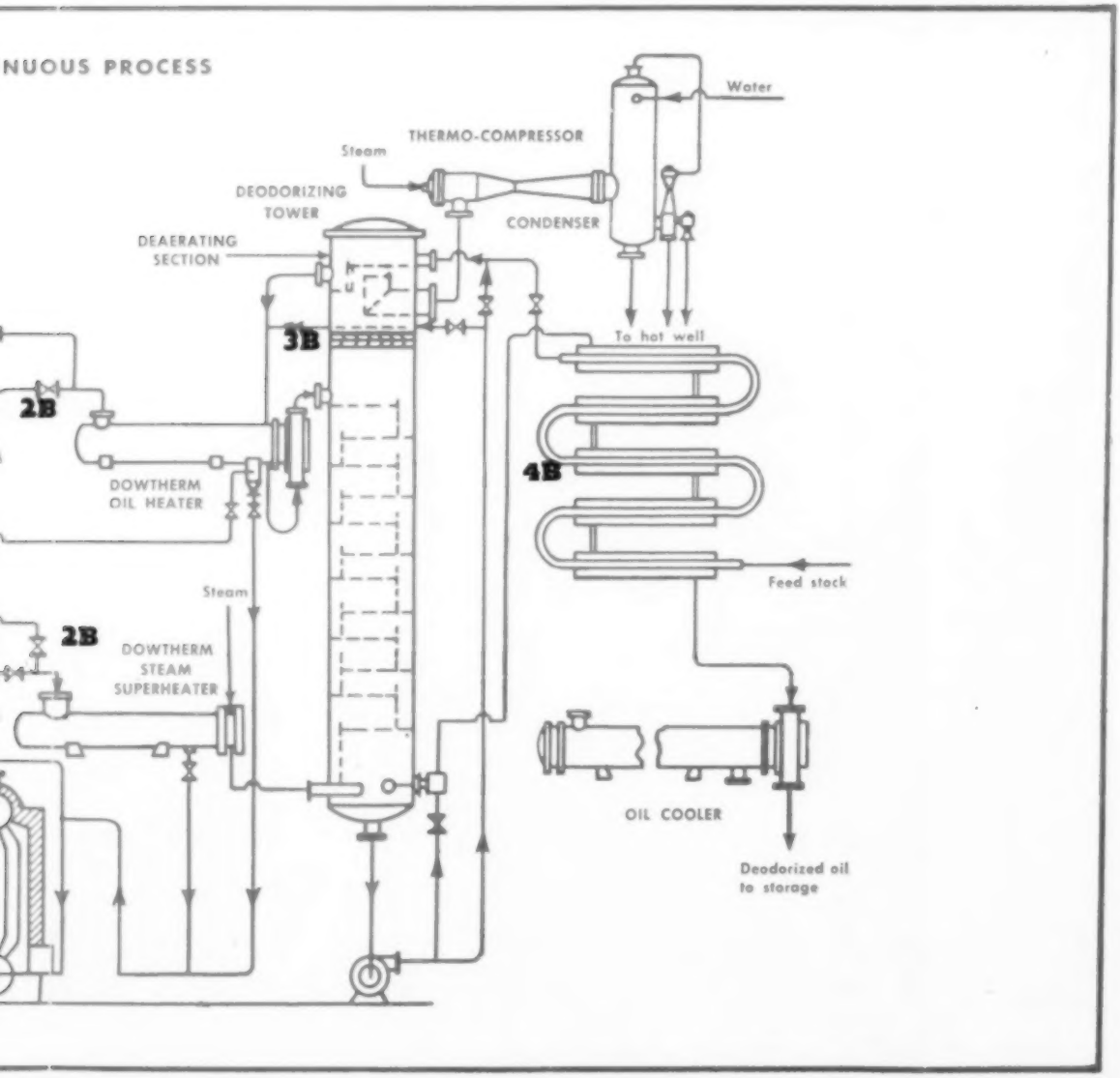




3B In continuous deodorizer partially heated oil is fed to top tray of deaerating section



4B From this heat exchanger (shown being installed) finished oil flows to cooler and then to storage



Running to Ruin

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THIS MACHINE tests TEXROPE Super-7 V-Belts — runs them at varying speed and load until they give out. A trained operator records results: How long did they last? What broke down first: Cords? Cover? Rubber compound? Does destructive heat develop?

Out of tests like this have come stronger cords—tougher, more wear-resistant covers — resilient, cooler-running rubber — vital improvements in design and construction. TEXROPE Super-7 V-Belts are today the BEST in 20 years of V-Belt experience.

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Call your nearest Allis-Chalmers office or dealer for ALL your V-Belt drive needs — TEXROPE Super-7 V-belts all types, all sizes; TEXSTEEL, TEXDRIVE and "Magic-Grip" Sheaves; VARI-PITCH Sheaves and SPEED CHANGERS. They're all engineered and backed by the originators of the Multiple V-Belt Drive for industry. ALLIS-CHALMERS, MILWAUKEE 1, WIS.

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Heat-Resisting Super-7
Stands temperatures up to 180°. The TEXROPE V-Belt for most drives.

Oil-Resisting Super-7
Neoprene cover protects core against moderately oily or greasy conditions.

Oil-Proof Super-7
Made of Neoprene throughout. Use it when the belt must swim in oil.

Static-Resisting Super-7
Recommended where explosion hazard exists. Static-conducting element throughout cover won't wear off.

TEXROPE Super-7 V-Belts result from the co-operative research of two great companies—Allis-Chalmers and B. F. Goodrich—and are sold exclusively by A-C.

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TEXROPE V-BELT DRIVES

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ONE
SOURCE OF SUPPLY
RESPONSIBILITY
STANDARD OF QUALITY

This all-Crane equipped evaporator is a typical example of the wide-open opportunity for chemical process industries to simplify piping procedures—from design to erection to maintenance.

So comprehensive is the Crane line of brass, iron, and steel piping materials, that it permits the utmost benefits of standardization—at every step of piping installations. For by standardizing on Crane materials, you gain this exclusive 3-way advantage:

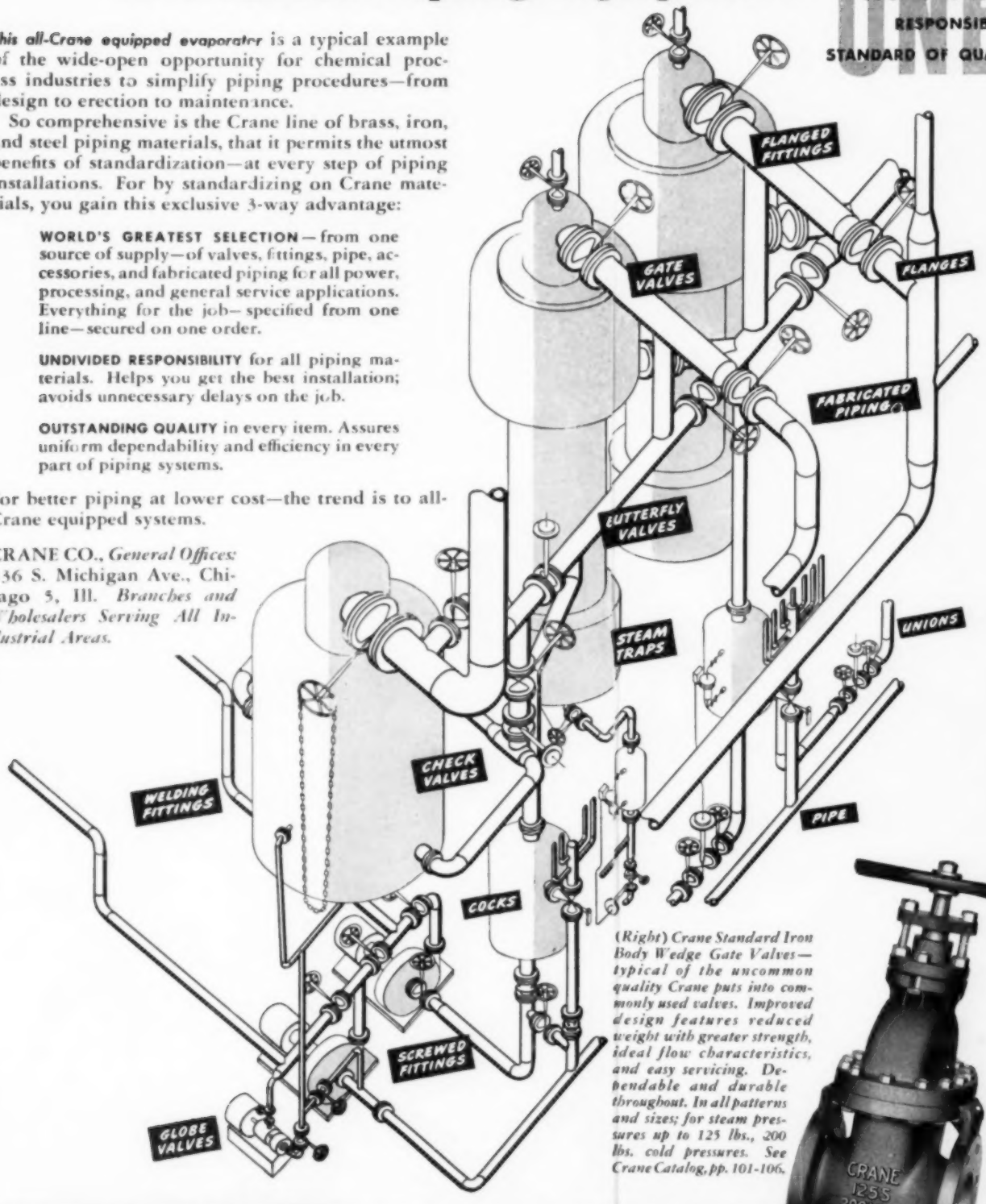
WORLD'S GREATEST SELECTION—from one source of supply—of valves, fittings, pipe, accessories, and fabricated piping for all power, processing, and general service applications. Everything for the job—specified from one line—secured on one order.

UNDIVIDED RESPONSIBILITY for all piping materials. Helps you get the best installation; avoids unnecessary delays on the job.

OUTSTANDING QUALITY in every item. Assures uniform dependability and efficiency in every part of piping systems.

For better piping at lower cost—the trend is to all-Crane equipped systems.

CRANE CO., *General Offices:* 836 S. Michigan Ave., Chicago 5, Ill. *Branches and Wholesalers Serving All Industrial Areas.*



(Right) Crane Standard Iron Body Wedge Gate Valves—typical of the uncommon quality Crane puts into commonly used valves. Improved design features reduced weight with greater strength, ideal flow characteristics, and easy servicing. Dependable and durable throughout. In all patterns and sizes; for steam pressures up to 125 lbs., 200 lbs. cold pressures. See Crane Catalog, pp. 101-106.

EVERYTHING FROM . . .

VALVES • FITTINGS
PIPE • PLUMBING
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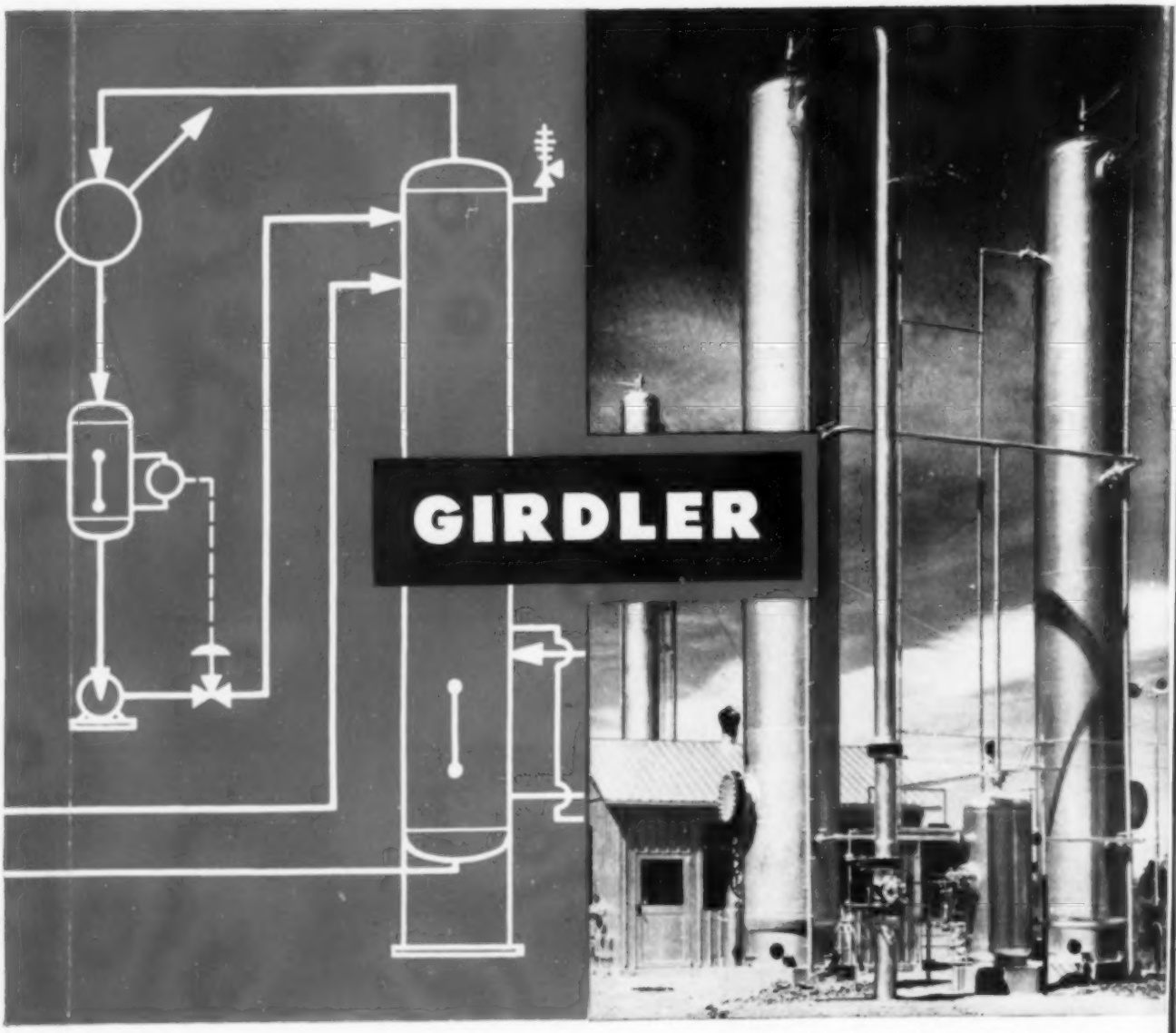
FOR EVERY PIPING SYSTEM



Typical Girbotol plant for removal and recovery of the acidic gases. Originators of the Girbotol Process, Girdler specialists in gas processes have designed and built more plants of this type than any other organization

Shortest distance from Plan to Plant in Gas Processes

IF you need a new gas processing plant and want it *right*, you can depend on GIRDLER'S outstanding experience in engineering and building the gas processing plants GIRDLER designs.

GIRDLER engineers are specialists in gas processes and they follow through from the very start to the very finish of the job—not just until the plant is installed but until the customer knows all about it and how to use it.

Several hundred GIRDLER-planned and GIRDLER-built gas processing plants are now successfully serving most of the big names in industry, as well as the United States Government. This includes processes for gas manufacture, purification, separation, and dehydration—processes solving problems concerning hydrogen sulphide, carbon monoxide, carbon dioxide, inert and controlled atmospheres, natural gas, refinery gases, liquid hydrocarbons, hydrogen, nitrogen.

• • •

For specific data showing what this wealth of experience means to you, write today giving an outline of your particular gas processing problem.

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311 Tulsa Bldg., Tulsa, Okla.

NEW PRODUCTS AND MATERIALS

R. W. PORTER, Assistant Editor

DRY CLEANING CHEMICALS

SIX NEW dry cleaning products are now commercially available after several years of development work in this field by the Pennsylvania Salt Mfg. Co., Widener Bldg., Philadelphia, Pa. Although development work started in 1940, it was not until after the war that full-scale production was made possible. Under the brand name of Erusto, these new materials are briefly identified as follows: Erusto filter soap is a freeflowing liquid dry cleaning soap for use in petroleum solvent systems equipped with filter and still, or filter only. It is designed to remove ground-in soil and many water soluble stains and may be used with added water. It is available in 5-gal. cans and 55-gal. drums. Erusto synthetic solvent soap is a concentrated balanced soap for use in synthetic solvent systems using perchlorethylene, trichlorethylene or carbon tetrachloride. It dissolves or emulsifies with chlorinated solvents forming a homogeneous mixture. It is available in 5-gal. cans and 55-gal drums. Erusto dry spotter is a completely volatile and non-flammable fancy spotter effective in oils, artists' paints, wax, chewing gum, carbon and printers' ink, glue, paint, tar, etc. and ironed-in grease stains. It is furnished in 1-gal. cans. Erusto pre-spotter is a non-flammable presetter designed to remove ground-in soil that is not removed during normal dry cleaning, particularly on articles that cannot be wet cleaned. It is said to be especially effective for hand brushing garments heavily soiled or containing obstinate stains. It may be obtained in 1-gal. cans. Erusto oil, paint and grease remover is a wet and dry prespotter soluble in Stoddard solvent, carbon tetrachloride, trichlorethylene, perchlorethylene and water. It may be mixed with Erusto dry spotter to remove most obstinate stains. It is available in 1-gal. cans. Erusto liquid wet cleaning soap is designed for wet cleaning, brushing and pre-spotting. It is a concentrated liquid cocoanut oil soap blended in balance with penetrating oils and solvents, giving a good lather, good cleaning efficiency and good finish. It is packed in 5-gal. cans and 55-gal. drums.

PIGMENT COLOR

NOW AVAILABLE to industry is a new pigment color recently announced by the E. I. du Pont de Nemours & Co., Wilmington, Del. This new pigment, under the name of Auric Brown, is claimed to give brighter, cleaner and more durable shades of brown colors for industrial enamels, trim paints, wallpaper and other coated papers, textiles and plastics. Consisting of chemically hydrated ferric oxide characterized by extremely small particle size, this new pigment is said to promise outstanding resistance to light for a wide range of products. It has been undergoing field tests for several years in automotive finishes, and is a constituent of the Duco Metalli-Chrome nitrocellulose lacquer finishes previously described in these columns. It is non-bleeding in the usual paint, enamel and lacquer finishes. It shows less tendency to chalk from outdoor exposure than standard iron oxides and pigments. It has light fastness and is resistant to alkalis. It is recommended as a background color in wallpaper and other paper coloring applications as well as in the field of beater coloring of paper and textile printing.

PROTECTIVE COATING

DEVELOPED as a substitute for white base and finish coatings by the Watson-Standard Co., Pittsburgh 12, Pa., a new series of protective coatings known as Rx Aluminum System has recently been announced. These new finishes are said to incorporate the latest war-proved technical advances and are adaptable to various baking cycles. This series of finishes is said to be of interest to lithographers, container manufacturers and metal fabricators because of the good printing surfaces on the base coat and the attractiveness of the finish coat. Reflector, stove and heater manufacturers should find the heat-resistant coating suitable for use at elevated temperatures. It is also suggested for use by toy manufacturers who can thus obtain smooth, tough and brilliant coatings formulated to withstand abrasion under severe handling.

COLORIMETRIC VITAMIN A REAGENT

ACCURATE estimation of vitamin A in blood serum, fish oils and pharmaceutical products is said to be aided by the new colorimetric reagent now manufactured by the J. B. Shohan Laboratories, 78 Wheeler Point Road, Newark 5, N. J. Under the brand name of Activated GDH, this new reagent is prepared from glycerol dichlorhydrin. Activated GDH develops a color with vitamin A which is stable for about eight minutes, permitting its absorption to be determined with ease. Previous methods using antimony trichloride produced a color which is so transient that its absorption must be read within 4 sec.

Even with antimony trichloride, the colorimetric procedure has been shown to give more accurate results than ultraviolet absorption methods. Use of this reagent has caused serious inconvenience because of its fleeting color, but also because it is poisonous, unstable, and corrosive to instruments. Activated GHD is claimed to be free from these disadvantages. In addition, it is unaffected by traces of moisture and leaves no film to interfere with accurate color determination. No special precautions are needed in the use of the reagent since it is stable and non-corrosive. This new product is available from the manufacturer at $9.50 per 500 g.

CONTENTS

WATER SOLUBLE CELLULOSE DERIVATIVES

PRODUCED by etherifying high alpha wood pulp with a mixture of different etherifying agents, a water soluble cellulose derivative known as Ethulose has been developed by the George G. Johnston Co., 865 First Ave., New York 17, N. Y. Ethulose is a white or slightly yellow flaky material which is odorless, tasteless and non-toxic. It is resistant against fats, oil and alkali. When an aqueous solution of 3 percent or greater of Ethulose is heated to 50 or 60 deg. C., it is converted into a thixotropic gel, while at lower concentrations simple floculation takes place. The process is reversible and a clear solution is again obtained upon cooling. The gelatin temperature is strongly affected by the presence of anions. Chloride and sulphate ions decrease the gelatin temperature. At high salt concentration a simple floculation takes place even at room temperature. Clear, smooth solutions can be easily made by stirring the flakes in cold water. Temperatures should be below 20 deg. C. in order to obtain the best possible results. The speed with which complete solution is obtained depends on the stirring. Clear solutions are normally obtained within one hour. However, for very rapid dispersion it is convenient to wet the flakes with hot water, after which cold water is poured

over the wetted material. The clarity of the solution is increased by lowering the temperature. Once prepared, however, the solution can be used at higher temperatures. By varying the molecular weight of the product in the manufacturing process, Ethulose can be obtained in a number of viscosity ranges.

The product is available at present in three viscosity ranges, as follows measured in a 2 percent aqeuous solution at 20 deg. C.: Ethulose A has a viscosity of 25-60 cp.; Ethulose B has a viscosity of 100-200 cp.; Ethulose C has a viscosity of 500-1,000 cp.. In the future higher viscosity types will also be available. Each type can be diluted up to 30 percent with alcohol such as methanol or ethanol, thus obtaining a lowering of the freezing point. Most non-volatile alcohols may be used as plasticizers for Ethulose, that is, glycol, glycerine, and sorbitol.

Ethulose is compatible with a great many thickening agents, such as gelatin, pectin, methyl cellulose, hydroxy-ethyl cellulose, polyvinyl alcohol, animal glue, sodium alginate, Irish moss, and others. Ethulose films are flexible in the unplasticized state, even when fillers are present. Such films are not sensitive to most of the common solvents and oils. This new material may be used as a film-forming material, sizing agent, binder, thickening agent, preservative colloid in aqueous solutions, and as an adhesive for paper and textiles. It may be kept for an unlimited time in clean stainless containers, and is resistant to cold and heat. It is completely neutral and perfectly free from odor and is edible and non-toxic. Ethulose is available in commercial quantities. The following uses have been suggested for Ethulose: Water emulsion paints, textile printing, cosmetics, shoe polishes, cold water paints, soap milling, pharmaceuticals, leather adhesives and finishes, paper sizing, wall paper adhesives and other applications.

PYROXYLIN COATING COMPOSITION

Introduced briefly in limited quantities in 1941, a new type of coating composition for automobile refinishing is again available from the E. I .du Pont de Nemours & Co., Wilmington, Del. It is designed to prevent bleed-through of maroons and reds in refinishing work. Under the brand name of Du Pont Bleeder Seal, this material is a pyroxylin product which is applied directly to an old red or maroon finish. Because of special ingredients which absorb bleeding pigments, new top coats are prevented from discoloring. It is fast drying and supplies good adhesion for top coats without affecting durability.

CUTTING OILS

Developed for use in high-temperature machining of metals a new series of transparent cutting oils has recently been announced by the Texas Co., 135 East 42nd St., New York, N. Y. Known as Cleartex Cutting Oils, A, A-1, B, BD, DD and Britex Cutting Oil B, these products now contain certain war restricted ingredients which greatly improve their color and performance. They are pale in color, pleasant of odor, and non-corrosive. These oils contain a combination of sulphur and chlorine, permitting high cutting speed without corrosion of metals. Addition of the hitherto restricted ingredients makes possible higher speeds in machining without danger of corroding finished or semi-finished metals, particularly non-ferrous metals such as brass and copper.

PLASTICIZING AGENT

Still in the development stage, a new plasticizer has been announced by the Monsanto Chemical Co., St. Louis 4, Mo. This product, under the brand name of Santicizer 160, is a relatively non-volatile plasticizer for polyvinyl chloride, polyvinyl chloride acetates, polyvinyl butyral, ethy cellulose and nitrocellulose. It is also compatible with many other resins to which it imparts desirable properties. It is claimed to be superior to many of the commonly used plasticizers in its permanence, oil resistance, flexibility and stability.

Chemical and physical properties of Santicizer 160 are given in the accompanying table. Because of its extensive compatibility and the desirable properties imparted to a wide variety of resins, this material should be of interest to the textile coating, plastic, protective coating, and electrical insulation manufacturers. In cellulose nitrate films it produces clear coatings, said to be superior to dibutyl phthalate in hardness, permanent flexibility, toughness and water permeability. Its light stability is slightly inferior to that of dibutyl phthalate. Santicizer 160 may be useful in automotive and furniture lacquers to provide tough abrasion-resisting finishes. This new plasticizer is comparable with cellulose tri-acetate to form coatings high in strength and water permeability. With ethyl cellulose, clear rigid sheets, molds, films and hot melt compositions may be produced which are of value to the packaging and protective coating field. In polyvinyl chloride and copolymer vinyl chloride-acetate sheets, Santicizer 160 imparts good drape, as well as excellent oil resistance, abrasion resistance, and heat stability. Low-temperature flexibility and volatility are sufficiently good for most applications. These probably suggest its use in coated textiles, electrical insulation, free films for packaging purposes, shower curtains, aprons, sheeting, etc.

Chemical and Physical Properties of Santicizer 160

Color	Approx. APHA 50
Odor	Very faint, characteristic
Crystallizing point, deg. C.	Glassy at −40
Sp. gr. at 25/25 deg. C.	1.116–1.120
Refractive index at 25 deg. C.	1.53–1.54
B.P. at 6.5 mm., deg. C.	Approx. 225
at 15.0 mm., deg. C.	Approx. 240
at 760 mm., deg. C.	Approx. 370
Acidity, percent as phthalic acid	<0.1
Solubility in water at 30 deg. C., percent	0.0003
Viscosity at 25 deg. C., cp.	50 (approx.)
at 0 deg. C., cp.	250 "
at −30 deg. C., cp.	3,600 "
Evaporation rate, gr. per sq. cm. per hr. at 105 Deg. C.	0.00150

This material is an active solvent for many of the synthetic resins and cellulose derivatives. It is quite stable under hydrolysis, light and heat. Low temperature flexibility and volatility are good for most applications.

MONOSODIUM GLUTAMATE

Volume production of a protein base meat-flavoring salt has recently been announced by the A. E. Staley Mfg. Co., Decatur, Ill. While this material, known as MSG, is an old commodity in the Orient, it has been used in this country during recent years for enhancing the flavor of many fine quality foods. This material is a white crystalline product with the appearance of finely granulated sugar. It is practically odorless and is readily soluble in water and possesses a strong meat flavor. It is used in the preparation of dehydrated canned soups, in various sauces, and in many kinds of prepared foods. The flavoring power of MSG is said to be 15 times stronger than can sugar and 7 times stronger than salt. One part dissolved in 3,000 parts of water is still preceptible to the taste. Monosodium glutamate occurs in both vegetable and animal protein. While this material has been manufactured for a number of years in pilot plant quantities by this company, commercial production will start when the plant soon to be constructed is completed.

RUBBERLIKE PLASTIC ELASTOMER

Commercially available on a limited scale in the form of a free-flowing, viscous material with a 100 percent solid content. Elastomer No. 105 is manufactured by the Electro-Technical Products, Inc., Nutley 10, N. J. This material, which will cure and polymerize by simple application of heat without pressure, may be cast, molded, extruded or applied by dip, spray, roll coating and other methods in any desired thickness in a single application. Elastomer No. 105 will not shrink nor expand dur-

Plastic "cocoon" developed by R. M. Hollingshead Corp., Camden, N. J., is used to protect equipment from exposure

MONSANTO

ortho-Nitrobiphenyl

(ONB)

are you looking for something new?

Monsanto ONB possesses an unusually wide range of compatibility. It can be used alone, or with other plasticizers—is applicable to the entire range of synthetic resins, from the cellulose esters and ethers through the vinyls and vinyl copolymers—is compatible with alkyds and some synthetic rubbers. It is suggested for use as:

1. **A low cost, active plasticizer for vinyl resins**
2. **A camphor substitute in cellulose nitrate compositions**
3. **A plasticizer in cellulose acetate molding compositions**
4. **A plasticizer in lacquer coatings to improve water, acid and alkali resistance**
5. **A stabilizer with some plasticizing action in varnishes**

Other uses may suggest themselves when you study the table of physical and chemical properties included here . . . Samples and technical information will be sent promptly on request. Contact the nearest Monsanto District Office, or write MONSANTO CHEMICAL COMPANY, Organic Chemicals Division, 1700 South Second Street, St. Louis 4, Missouri.

District Offices: New York, Chicago, Boston, Detroit, Charlotte, Birmingham, Cincinnati, Los Angeles, San Francisco, Seattle, Montreal, Toronto.

MONSANTO CHEMICALS
SERVING INDUSTRY...WHICH SERVES MANKIND

PHYSICAL AND CHEMICAL PROPERTIES
(From Typical Analyses)

Molecular Weight	199.20
Melting Point	Approx. 35°C. (Supercools Readily)
Boiling Point at 10 mm.	Approx. 172°C.
Boiling Point at 760 mm.	Approx. 330°C.
Refractive Index at 25°C.*	Approx. 1.613
Specific Gravity at 40°/15.5°C.	Approx. 1.189
Viscosity at 25°C.*	38 Centipoises
Viscosity at 45°C.	12 Centipoises
Weight/Gallon	Approx. 9.9 lbs.
Flash Point	143°C. (289.5°F.)
Fire Point	179°C. (354.5°F.)
*Obtained on supercooled material.	

SOLUBILITY: Practically insoluble in water (either hot or cold). Readily soluble in—

Benzene	Ethyl Acetate	Mineral Spirits
Ethyl Alcohol	Amyl Acetate	Pine Oil
Methyl Alcohol	Ortho-Dichlorobenzene	Turpentine
Ether	Carbon Tetrachloride	Linseed Oil
Acetone	Perchlorethylene	Soya Bean Oil
Methyl Ethyl Ketone	Glacial Acetic Acid	Corn Oil

TOXICITY: For information, write for technical bulletin O-D-700.

ing the curing process, and will take even the finest details of the mold. After curing it becomes a solid elastomeric mass, similar to pure gum rubber. It is claimed to differ from rubber and other similar plastic compounds in its resistance to most solvents, including aromatic hydrocarbons, oils, acids, alkalis and water, and will not oxidize and harden on aging. It is said to retain its flexibility even at extremely low temperatures, and will not sustain combustion. Recommended curing temperature is 160 deg. C., although special compounds may be formulated to be cured at as low a temperature as 95 deg. C. Curing time depends on the thickness of the finished product, approximately five minutes per one-eighth inch of thickness is required at 160 deg. C. It is available in returnable shipping containers of 1, 5, 30 and 50-gal. It is priced at 75c. per lb. up to 250 lb., and 73c. per lb. from 250 to 500 lb. Properties are given in the accompanying table.

Properties of Elastomer 105

Sp. gr.	1.4 to 1.7
Tensile strength, lb. per sq. in.	200 to 1,100
Elongation, percent	200 to 350
Dielectric strength, 0.015 thickness, v. per mil	500 to 750

CLEANING SOLUTION

Effective cleaning in a number of applications can be obtained by the use of a new series of cleaning agents marketed under the name of Ferrex, according to Turco Products, Inc., 6135 South Central Ave., Los Angeles, Calif. Ferrex, a low-cost, non-flammable hot tank cleaner, is claimed to remove carbon, paint, grime, grease, gums, heat-hardened resins and heavy dirt from steel and other ferrous metals without the necessity of scraping or using other manual methods. Carbon and paint stripping qualities of this product result from a combination of the two cleaning agents, Ferrex B an alkaline solid, and Ferrex C, a direct action liquid solvent. It is used as a hot water solution in a tank preferably with air agitation, to penetrate and wet out carbon and lead deposits, emulsified petroleum residues and to saponify animal and vegetable oils. Ferrex contains no inert ingredients and may be used over and over again with little depletion of strength It is recommended as a fast and safe economical and effective chemical agent for hot tank cleaning operations, for automotive motor reconditioning, and in cleaning petroleum, railroad, diesel and industrial equipment and tools as well.

FLUORINE COMPOUND

Now commercially available from the General Chemical Co., 40 Rector St., New York 6, N. Y., boron fluoride etherate is said to be a valuable catalytic chemical of wide potentialities. Having a chemical composition of $(C_2H_5)_2OBF_3$, some of the important reactions which may be catalyzed by this compound include polymerization of unsaturated compounds such as olefins, diolefins, vinyl ethers, fatty oils, and terpenes. The product may be solid polymers useful as plastics or liquids as in the body of drying oils for paints and varnishes. Another reaction is the condensation of

Safeguarding the petroleum products they're carrying—no rusting in tanks of Alcoa Aluminum to contaminate these products. No sludging or gumming of gasolines to cause trouble. Long life and lower upkeep are assured, too, because of aluminum's ability to resist corrosion.

Good for *your* business, too.

Tanks of Alcoa Aluminum are equally valuable for transporting and storing hundreds of other materials. The purity of your products is preserved—their color, taste and odor are unaffected.

By carrying bigger payloads, because of the lighter weight of aluminum tanks, you get a bonus equivalent to hundreds of extra trips in their lifetime.

Alcoa's nearby office can tell you what chemicals and compounds can best be handled in aluminum. Or write ALUMINUM COMPANY OF AMERICA, 2151 Gulf Bldg., Pittsburgh 19, Pa.

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IN EVERY COMMERCIAL FORM

aromatic nuclei with olefins and diolefins, paraffin, and aromatic nuclei or olefins with acid. It may be used as a cyclizing agent for rubber and as a esterification catalyst. It may also be used as a catalyst in the synthesis of aliphatic acids from alcohols and carbon monoxide. Physical properties of this new catalyst material are shown in the accompanying table.

Physical Properties of Boron Fluoride Etherate

Mol. wt.	141.9
M.p., deg. C.	less than —60
B.p., deg. C.	125
Sp. gr. at 25 deg. C.	1.14
Percent BF_3, min.	47.3

AIR DRYING LACQUER ENAMEL

KNOWN as Prismlac, a new lacquer enamel has been announced by Maas & Waldstein Co., 438 Riverside Ave., Newark, N. J. This enamel dries to prism-like formation and is claimed to produce unusually attractive crystallizations on glass, steel, aluminum, brass and copper. It can also be used on close grain wood, such as birch and maple. It is available in a variety of colors, including black, red, maroon and green, and is also available as a clear finish.

ANTI-CORROSION COATING

RECENTLY announced by the Buchanan Associates, Inc., 220 East 42nd St., New York 17, N. Y., are three new products now being manufactured on a commercial scale. The first of these is a corrosion-resistant paint consisting of a synthetic plastic material. This coating is claimed to have good flexibility, adhesion, as well as being tough and durable. It is non-saponifiable, and is grease, oil, acid, alkali, water, alcohol and abrasion resistant. It dries rapidly without paint odor. It is said to be good for use in chemical plants, dairies, and any other place where painted surfaces are subject to chemical fumes, or where the surface is washed with strong caustics. It is available in clear, black, white and several other colors.

The second of these is a rustproof fender coating consisting of a special synthetic resin solution for prevention of rust and corrosion. It may be applied by brush or spray methods, and provides a tough, pliable, protective coating with good adhesion and durability. It was developed to coat the under sides of automobile fenders and may be used for all other metal articles susceptible to the highly corrosive action of salt atmosphere and high humidity. It is claimed to resist water, oil, heat, salt spray, calcium chloride fumes, acids, and alkalis. It will also withstand extreme temperature changes. The third of these products is a fast drying synthetic resin base insulating solution. It has good dielectric strength and is claimed to be resistant to salt spray, water, oil, heat, moisture and corrosion. It may be applied by either brush or spray method. It may be used to protect motors, coils, magnetos, ignition systems of all types of combustion engines, marine, diesel, etc. Generally speaking, it may be use for all types of electrical equipment. It has a dielectric strength in a 1-mil film of 1,030 v. It is available in 1- and 5-gal. cans and regular size drums.

CHEMICAL ENGINEERING NEWS

NEW SOLVENT EXTRACTION SYSTEM INCREASES YIELD

A NEW SOLVENT, one-step, extraction system, which is claimed to increase the oil yield from cottonseed, linseed, castor and most other oil-bearing seeds, nuts and beans to more than 98 percent of the available oil, about 6 percent greater than possible with other known processes, has been developed by the Sherwin-Williams research staff at the company's Cleveland linseed oil mill. Patent applications are pending covering the processes used in the system and certain features of the equipment employed in carrying out the processes. All of the equipment is of a new design.

In the new system one plant can be used interchangeably for the extraction of oil from castor beans, cottonseed, cocoa beans and many other oil-bearing beans, seeds and nuts. In addition to its flexibility, it requires only two-thirds the plant space needed by other processes.

Seeds and beans processed by hydraulic or expeller pressure methods and then treated batchwise with a solvent to win much of the remaining available oil require up to 3 hr. to convert the oil in the raw seed to the finished product. The new method cuts the time to one hour. The company states that in tests in their pilot plant, all the oil won was top grade quality. The faster system makes the residual meal marketable for use in the manufacture of glue, resins, emulsions, cloth, paper and other similar products since in the new process the proteins are not degraded.

A contract has been signed between Sherwin-Williams and the Blaw-Knox Co., giving Blaw-Knox the exclusive right to grant sub-licenses. Blaw-Knox is now building the first of the new plants on a site adjacent to the Sherwin-Williams Cleveland linseed oil mill with completion scheduled for late this year.

DUPONT WILL TRIPLE NYLON PRODUCTIVE CAPACITY

FOLLOWING earlier reports that E. I. du Pont de Nemours & Co. had purchased a 600-acre tract near Chattanooga, Tenn., on which a nylon plant would be erected, it is now made public that the company is ready to go ahead with the project and has made application for construction to the Civilian Production Administration. Estimated cost of the new plant is $20 million and approximately 18 months will be required for construction and installation of equipment.

R. A. Ramsdell, manager of the company's Nylon Division said the new plant facilities plus expansions now under way at existing plants will make it possible to triple the current output of nylon textile fibers. He referred to a long-range program for increasing nylon production and said the Chattanooga plant was a part of this program. From February 1942 until after the close of the war the entire production of nylon was allocated by the government for specific war needs. During that period, expansion of manufacturing facilities was limited to the requirements of the War Production Board.

The first nylon plant was built at Seaford, Del., and began operations in December 1939, the original capacity having later been increased. The second plant, built at Martinsville, Va., started production late in 1941. A new unit is now under construction and is scheduled for completion next year.

DAVISON PURCHASES MINING PROPERTIES IN FLORIDA

THE Davison Chemical Corp. has purchased the mining properties of the Southern Phosphate Corp., Bartow, Fla., which will become the phosphate rock division of Davison. The Southern Phosphate Corp. is engaged in mining and refining Florida land-pebble phosphate rock. The surface mining of Florida phosphate rock is done by a combination of electric dragline excavators, and hydraulic mining.

In announcing the purchase of the Southern Phosphate properties, the company stressed the fact that the present operating personnel of the Southern Phosphate Corp. will be retained. William H. Gabeler, formerly superintendent of the corporation's Curtis Bay Works, and more recently a member of the engineering and process division of the Davison Corp., has been appointed manager of the new phosphate rock division, with headquarters in Baltimore, Md.

CELANESE CONSTRUCTS NEW RESEARCH CENTER

CONSTRUCTION of a $3 million research center by the Celanese Corp. of America is well under way and initial operations will probably start very soon. The center is an outgrowth of the Celanese Chemical plant at Bishop, Tex., where chemicals are produced from natural gas. The center's prime research purpose will be for investigation and research connected with chemicals that can be derived from petroleum or petroleum derivatives. It also will conduct research to utilize present products and other processes to make new or improved materials, in addition to training technicians and operators.

Located on a 50-acre tract six miles west of Corpus Christi, the research laboratory will have its own maintenance, construction and fine instrumentation departments and its facilities will include the latest developments in low-temperature ultimate distillation apparatus, spectrometric analysis and electronic devices. Joseph E. Bludworth is the director of petroleum chemicals research and development division of the company.

SPRAY PACKAGING METHOD AIDS STORAGE PROBLEM

DEVELOPED during the war to protect large quantities of naval equipment stored in exposed places, an improved spray packaging method is now available for commercial use. Working in conjunction with the Insul-Mastic Corp. of America, the R. M. Hollingshead Corp. Camden, N. J., has developed a new packaging plastic consisting of modified film-forming vinyl resins, carried in volatile solvents. This plastic packaging process is generally carried out completely by spray application although for some types of work dipping is used.

The spray packaging method is a simple and quick way to package parts, assemblies, or complete machines, regardless of size or complications in shape. It consists of an initial spray operation which bridges large openings and voids with long weblike plastic filaments that completely enclose the item being packaged. Subsequent spray applications produce a tough, durable, flexible moisture impervious package which withstands exposure to wind, rain, snow, and sunlight over long periods.

ELECTROCHEMICAL SOCIETY CONGRESS IN TORONTO

PLANS have been announced for a four day meeting in Toronto, Canada, of the Electrochemical Society's 90th Congress to be held from October 16 to 19. Registration of members and guests will start at the Hotel Royal York in the afternoon of October 16, and will continue to noon October 19. A reception and dinner in the evening of October 17 will honor Dr. H. Jermain Creighton, 1946 Acheson Medallist. Speakers at the dinner will include Wm. C. Moore, president of the society; Sherlock Swann, Jr.; A. F. G. Cadenhead; and H. Jermain Creighton.

Scientific and technical sessions will be held on the following subjects: war-time developments in electrodeposition, rectification and power supply for the electrolytic industry, new plastic insulators, new dry cells, and theoretical electrochemistry.

CALCO REORGANIZES ITS DYE APPLICATION LAB

MOVING to meet its growing activities, the Dye Application Laboratories, Calco Chemical Division, American Cyanamid Co., Bound Brook, N. J., has been consolidated into three main divisions, namely; the textile division, the leather, paper and plastic division, and the evaluation and testing division.

Dr. A. L. Peiker has been appointed

associated manager and administrative assistant to W. H. Watkins, manager of the Dye Application Laboratories. O. W. Clark has been appointed assistant manager in charge of the cotton, viscose rayon and resin bonded pigments section of the textile division. H. E. Millson has been appointed assistant manager in charge of the wool, nylon, acetate and specialties section of the textile division. F. O. Sundstrom has been named assistant manager of the plastics and specialties section of the leather, paper and plastic division. In the evaluating and testing division, R. R. Sleeper will be in charge of new product evaluation and F. C. Dexter in charge of pigment testing and identification.

BATTELLE GRADUATE RESEARCH FELLOWSHIPS OFFERED

FOR THE year beginning this fall, Battelle Memorial Institute, Columbus, Ohio, will appoint a limited number of graduate research fellows and postdoctoral

CONVENTION CALENDAR

Northeastern Wood Utilization Council, conference on new developments in hardwood pulp, New York State College of Forestry, Syracuse, N. Y., October 2.

American Gas Association, annual convention and exhibit, Atlantic City, N. J., October 7-12.

The Electrochemical Society, Inc., fall meeting, Hotel Royal York, Toronto, Canada, October 16-19.

Engineering Society of Western Pennsylvania, seventh annual water conference, Hotel William Penn., Pittsburgh, Pa., October 28-30.

American Oil Chemists' Society, annual fall meeting, Edgewater Beach Hotel, Chicago, Ill., October 30 to November 1.

Chemical Market Research Association, Palmer House, Chicago, Ill., October 31.

Federation of Paint and Varnish Production Clubs, annual convention and paint industries show, Hotel Claridge, Atlantic City, N. J., November 4-6.

National Paint, Varnish & Lacquer Association, annual convention, Atlantic City, N. J., November 6-8.

American Institute of Chemical Engineers, annual meeting, Bellevue Stratford Hotel, Philadelphia, Pa., November 17 to 20.

National Metal Exposition, Municipal Auditorium, Atlantic City, N. J., November 18-22.

Seventeenth National Exposition of Power and Mechanical Engineering, Grand Central Palace, New York, N. Y., December 2-7.

Seventh International Heating and Ventilating Exposition, Lakeside Hall, Cleveland, Ohio, January 27-31, 1947.

Second National Plastics Exposition, Coliseum, Chicago, Ill., May 5-11, 1947.

SOME "EARTHY" FACTS

...about Packaging Economy

Fuller's Earth a "Natural" for St. Regis Packaging System: —
....Container Costs Cut...14%
....Labor Costs Cut.....75%
....Production Potential "Upped".....180%

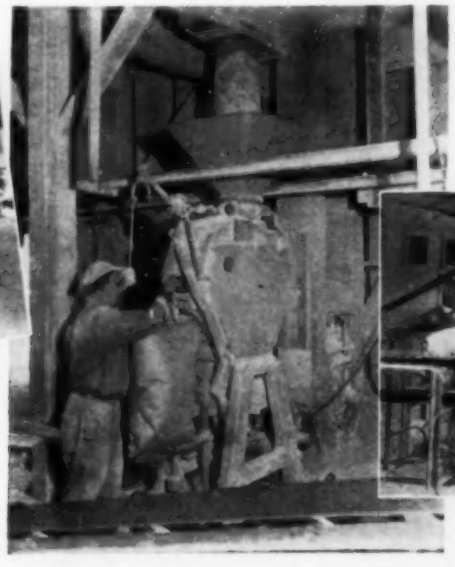
Whether you are packaging chemicals, foods, fertilizer or rock products, a St. Regis Packaging System individually designed to suit your product will effect worth-while economies. This eighth in a series of Multiwall success stories relates the experiences of the Floridin Company, Warren, Pa., processors of fuller's earth under the trade names of Floridin and Florex.

In 1945 this company installed a St. Regis 301-FB packer and began using 50-lb. Multiwall paper valve bags instead of 125-lb. burlap bags. Not only was there a saving of 45¢ per ton in container cost after switching to Multiwalls but there was also an appreciable reduction in labor costs.

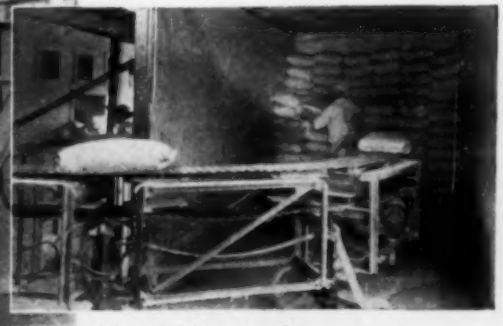
Under the old system eleven men were required to package 100 tons per day in 125-lb. burlap bags. With the St. Regis Packaging System, labor costs dropped from 71½¢ per ton to 18½¢ . . . a saving of 75%. Company officials estimate that with a battery of four St. Regis packers and a crew of only eight men they will be able to increase production to 280 tons per day . . . *an increase of 180%.*

For the full picture story on how the Floridin Company reduced container costs, increased production potential, and cut labor costs by the installation of a St. Regis Packaging System and streamlined mechanized handling equipment, mail the coupon. You will find the same basic principles applicable to *your* business.

The filled Multiwalls are dropped on a conveyor belt which carries them to a freight car.



One man operates this St. Regis packer, which simultaneously fills and weighs 50-lb. Multiwall valve bags.



This flexible, portable conveyor delivers filled Multiwalls to the box car. Note flat, compact manner in which Multiwall valve bags stack.

MULTIWALL

ST. REGIS SALES CORPORATION

(Sales Subsidiary of St. Regis Paper Company)

NEW YORK 17: 230 Park Ave. CHICAGO 1: 230 No. Michigan Ave.
BALTIMORE 2: 2601 O'Sullivan Bldg. SAN FRANCISCO 4: 1 Montgomery St.

Mail this coupon for the complete story

Allentown Birmingham Boston Cleveland Dallas Denver Detroit Franklin, Va. Los Angeles Nazareth, Pa. New Orleans No. Kansas City, Mo. Ocala, Fla. Oswego, N. Y. Seattle Toledo

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Without obligation, please send me full details regarding "Case History" No. 8, outlined above.

NAME_____

COMPANY_____

ADDRESS_____

research associates to conduct investigations of a fundamental character in the Battelle laboratories.

Associates and fellows are brought together for a year's study at Battelle for the purpose of developing highly trained research men, primarily for careers in industrial research. Appointees devote their full time to their own research projects in the Battelle laboratories under the guidance of the technical staff. The projects must be of a fundamental or general nature, leading to the discovery of scientific principles or the gathering of significant new data. The findings are to be prepared for publication as a service to science and industry.

Fellowships are open to men seeking the master's or doctor's degree in universities and engineering schools and are available normally during the year at the end of which the holder expects to receive his degree.

Associateships are open to young men who have completed their academic training prior to coming to Battelle and have shown exceptional aptitude for research. Preference is usually given to those holding a Ph.D. degree. Application may be made to Dr. J. R. Van Pelt at the Institute.

MONSANTO PLANS TO ENLARGE POLYSTYRENE OUTPUT

PRODUCTION of polystyrene at the rate of more than 80 million pounds a year early in 1947, is planned by the Monsanto Chemical Co. To attain this production it will further enlarge its plant facilities at Springfield, Mass., and will install a major polystyrene plant at Texas City, Tex., adjoining the 50,000 ton styrene monomer plant which it built and operated for the Rubber Reserve, and is purchasing for $9.5 million from the WAA. The government styrene unit of a styrene-butadiene plant at Kobuta, Pa., has been sold for $3.3 million to Koppers Co., Inc.

MATHIESON ALKALI ENTERS FIRE PROTECTION FIELD

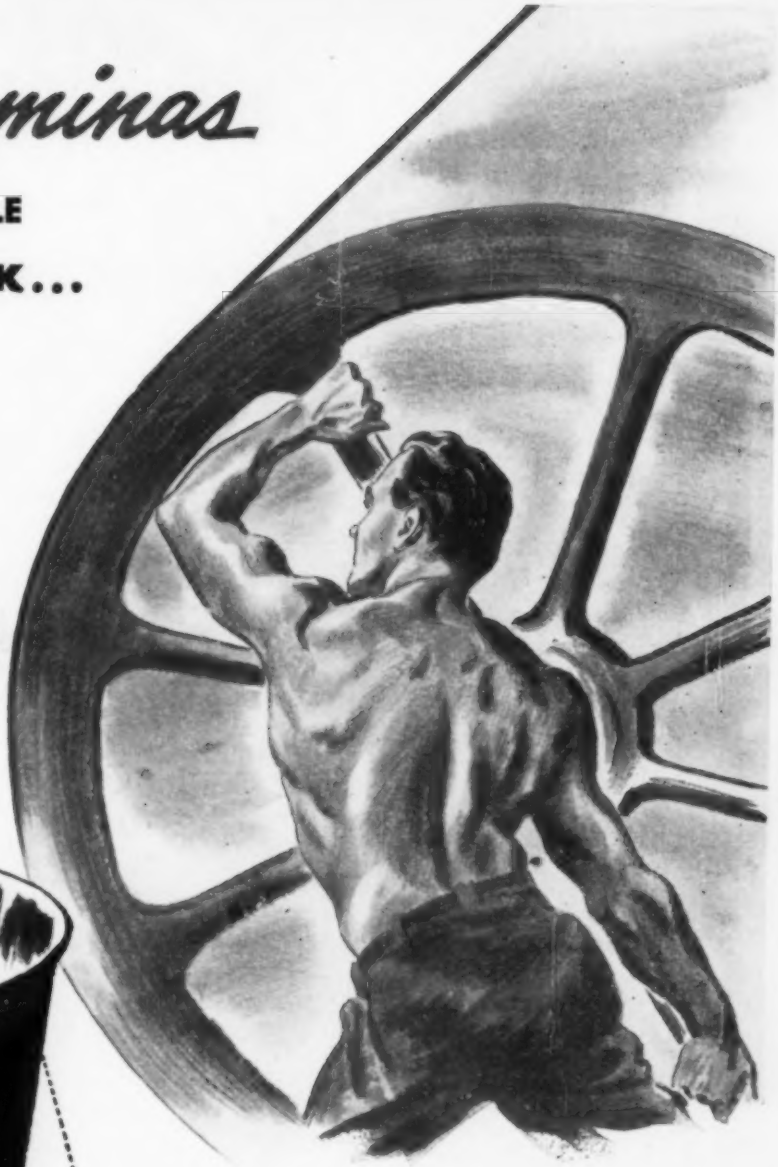
THE Mathieson Alkali Works has entered the fire protection field with both high and low pressure carbon dioxide equipment. The company operates one of the largest carbon dioxide plants in the world at Saltville, Va. Harry Ensminger will head the new fire protection department, with headquarters at the company's New York offices.

NEW PIGMENT COLOR PROCESS PLANNED BY DUPONT

PLANS for installation of the first full-scale process for the continuous manufacture of precipitated pigment colors were announced recently by the pigments department of the Du Pont company. Installation will be made in buildings already available at the company's pigment plant in Newark, N. J. The company stated that the new process represents the first fundamental change in the manufacture of chrome pigment colors in many years. The installation is the result of extensive research and will reduce average

Alorco Aluminas

PLAY A DOUBLE ROLE IN CATALYTIC WORK...



As a Drying Agent

Anhydrous catalysts need moisture-free feedstocks. Otherwise, efficiencies are likely to fall off seriously and reactions may go awry.

Alorco Activated Aluminas provide dependable, low dew point drying for feedstocks, helping to secure maximum production and to keep processes "on the beam". They serve year after year, their drying ability being restored simply by reactivating them by heating.

As Catalysts and Carriers

Alorco Aluminas are serving the petroleum, synthetic rubber, and chemical industries as active and auxiliary catalysts, and as carriers. Their physical properties suit them to long life with continued high productive capacity. They are able to withstand high temperatures.

Because Alorco Aluminas are high in purity and carefully controlled in chemical content, there's less likelihood of side reactions and poisoning.

Whether your problem is one of drying or catalysis, it will pay you to investigate the use of Alorco Aluminas. Tell us your needs and we'll advise on the types best suited. Call the nearby Alcoa office, or write ALUMINUM ORE COMPANY, Subsidiary of Aluminum Company of America, 1910 Gulf Building, Pittsburgh 19, Pennsylvania.

ALUMINUM ORE COMPANY

Aluminas and Fluorides

ALORCO

SUBSIDIARY OF ALUMINUM COMPANY OF AMERICA

processing time from a period of four or five days to a few hours. It will provide new facilities for the manufacture of chrome pigments.

The new process will replace batch handling with a continuous flow of raw material and semi-finished pigments through all processing stages. This is expected to improve quality as well as increase production. The continuous process will result in better control in the precipitation and drying operations in particular, and is expected to be ready for operation in five months. It will be installed in the building in which silica gel was manufactured for the government during the war.

MANY INNOVATIONS COMING TO NATIONAL POWER SHOW

INNOVATIONS in power equipment which have multiplied in recent months will have their first comparative display at the 17th National Exposition of Power and Mechanical Engineering. Many exhibitors are pursuing development work during the summer on new projects which they plan to have ready for announcement when the Exposition opens in Grand Central Palace, New York, during the first week in December.

SNELL CHEMISTS VOTE FOR UNION

AT AN election held August 23, the Technical and Scientific Division of the United Office and Professional Workers of America was the winner in a National Labor Relations Board election for chemists employed at the Foster D. Snell Laboratories. Foster D. Snell, head of the laboratories, is a prominent leader in the American Chemical Society and has vigorously opposed the organization of chemists in his employ. Only after the NLRB had denied the company's plea that its chemists were not within the scope of collective bargaining, was an election held.

TEXAS CHEMICAL EXPANSION SUMMARIZED IN REPORT

IN A REPORT by Elmer H. Johnson of the University of Texas, Bureau of Business Research, he stated that among the new industries being established in Texas are several utilizing hydrocarbons supplied as byproducts from petroleum refineries or from natural gas.

Three new plants are being constructed and will be in operation early next year. DuPont is erecting a $30 million plant at Orange for the manufacture of chemical intermediates for nylon, presumably from petroleum hydrocarbons. The Jefferson Chemical Co. is constructing a large plant at Port Neches for the production of intermediates from hydrocarbon gases supplied by the nearby Texas Co. refinery, and American Cyanamid will construct a plant at Port Neches for the production of a variety of industrial chemicals.

In the field of inorganic chemicals, Diamond Alkali Co. has announced it will build a $6,000,000 plant on the Houston ship channel which will manufacture caustic soda, chlorine, hydrogen and hydro-

ical Co. at Texas City, Dow Chemical Co. production of magnesium at Freeport.

Other concerns in Texas which have been producing chemicals from hydrocarbons include Carbide and Carbon Chemical Corp. at Texas City, Monsanto Chemical Co. at Texas City, Dow Chemical Co. at Freeport, Celanese Corp. of America at Bishop, as well as a number of petroleum companies including Humble, Shell, Phillips, Gulf, Atlantic and Sinclair.

PENNSALT ACQUIRES FLUORSPAR MINE

In a recent transaction the Pennsylvania Salt Mfg. Co. purchased the Kentucky Babb Fluorspar mine near Salem, Ky. The mine and surface inventory were purchased from Roberts and Frazer, active in other fluorspar mining operations as the Kentucky Fluorspar Co. Pennsalt has completed underground explorations of the Kentucky Babb mine but is not now producing from it.

DETROIT PAINT AND VARNISH GROUP ELECTS OFFICERS

Members of the Detroit Paint and Varnish Production Club have elected the following officers for their 1946-47 year: president, Rolland Peters, Ditzler color division; vice-president, George Moule, Rinshed Mason Co.; treasurer, John S. Ayres, Cook Paint & Varnish Co.; and secretary, John H. Colbeck, Wyandotte Paint Products Co.

CORNING GLASS WORKS PLANS PILOT PLANT

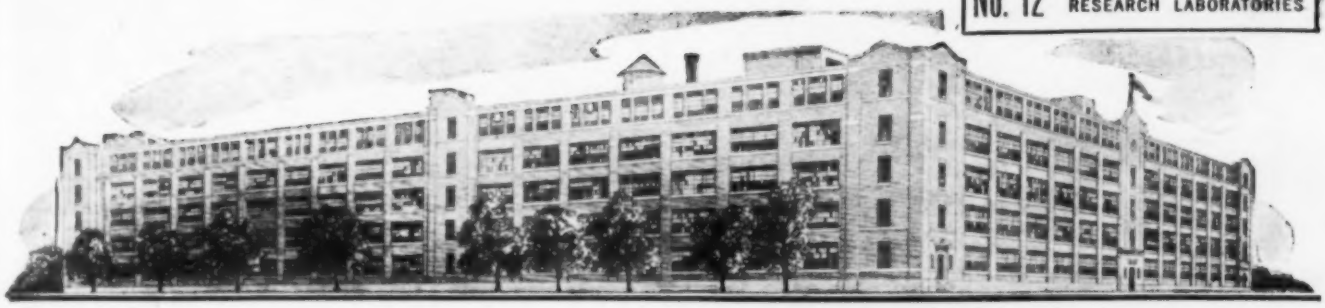
Plans of Corning Glass Works for a pilot plant especially designed to facilitate the manufacture of new products and to develop new manufacturing methods, were made public recently. The new plant will be the first of its kind in the glass industry. It will be located in Corning, N. Y. This is the company's third postwar step in a long-term expansion and improvement program which began last fall with the purchase of new manufacturing facilities in Canada. Another unit in West Virginia, operated under lease during the war, also has been recently purchased from the War Assets Administration.

The pilot plant will be equipped initially with one continuous furnace and modern machinery. It will permit experimental work to be conducted without interfering with the production schedules of any of the manufacturing plants.

BATTELLE INSTITUTE INSTALLS NEW UNIT

New chemical engineering laboratory facilities for the investigation of new industrial processes and products on a pilot-plant scale have been installed at Battelle Institute, Columbus, Ohio.

Among the facilities of the enlarged laboratory is a glass-enameled unit, consisting of a 150-gal. steam-jacketed reaction and distillation kettle, fractionating column, condenser, and two 100-gal. feed or receiver vessels, for operation at moderate pressure or under vacuum. Auxiliary



Aero* Glycolonitrile

New Highly Reactive Intermediate... Alcohol and Nitrile Combined

With the chemical properties of alcohol and nitrile combined, varied application for glycolonitrile is found in the broad fields of organic synthesis — plastics, pharmaceuticals, dyestuffs, photographic chemicals, preparation of important organic intermediates and numerous others.

A representative few of the compounds which can be made are:

Chloracetonitrile $Cl\text{-}CH_2\text{-}CN$

Glycolamide $HO\text{-}CH_2\text{-}CONH_2$

Amino-acetonitriles $NH_2\text{-}CH_2\text{-}CN$, $NH(CH_2\text{-}CN)_2$, $N(CH_2CN)_3$

Anilinoacetonitrile $C_6H_5\text{-}NH\text{-}CH_2\text{-}CN$

Dimethylaminoacetonitrile $(CH_3)_2N\text{-}CH_2\text{-}CN$

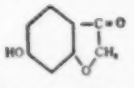
Glycine $NH_2\text{-}CH_2\text{-}COOH$

Cyanomethyl esters $R\text{-}C(:O)\text{-}O\text{-}CH_2\text{-}CN$

Dicyanomethyl carbonate $CO(O\text{-}CH_2\text{-}CN)_2$

Cyanomethyl chloroformate $Cl\text{-}C(:O)\text{-}O\text{-}CH_2\text{-}CN$

6—hydroxy-3-(2)-benzofuranone



AERO GLYCOLONITRILE is available in research quantities from our pilot plant in the form of a 50% aqueous solution which has a pH of approximately 2.8 and a specific gravity of 1.042 @ 20°C.

Other Organic Nitrogen Chemicals

Acrylonitrile $CH_2=CH\text{-}CN$

Guanidine compounds $H_2N\text{-}\overset{NH}{\overset{\|}{C}}\text{-}NH_2$

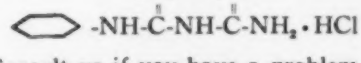
Guanylurea sulfate $(H_2N\text{-}C(:NH)\text{-}NH\text{-}C(:O)\text{-}NH_2)_2H_2SO_4$

Lactonitrile $CH_3\text{-}CHOH\text{-}CN$

Dicyandiamide $H_2N\text{-}C(:NH)NHCN$

Ethylene cyanohydrin $HO\text{-}CH_2\text{-}CH_2\text{-}CN$

Phenyl biguanide hydrochloride



Consult us if you have a problem in the field of organic nitrogen chemicals.

*Reg. U.S. Pat. Off.

AMERICAN
Cyanamid
COMPANY
Industrial Chemicals Division

Headquarters For Nitrogen Chemicals

SAMPLES AND TECHNICAL DATA

American Cyanamid Company
Section ND, Synthetic Organic Chemicals Dept.
30 Rockefeller Plaza, New York 20, N. Y.

Gentlemen:

☐ *Send sample of Aero Glycolonitrile* ☐ *Send technical data sheet*

*Name*_____

*Position*_____

*Company*_____

*Address*_____

stainless steel equipment includes a stainless steel pressure filter and the usual equipment needed for measurement and control in studies of the unit operations involved in industrial processes.

Although the recently completed unit was built to provide operating and design data for the production of special organic acids and esters developed in Battelle research, it has been made flexible enough to be used for other purposes.

COSHOCTON PLASTICS PLANT STARTS PRODUCTION

INITIAL production in a $5 million factory that is designed to be the largest and most modern plastics laminating plant in the country was started by the General Electric Co. plastics division recently. Although construction is by no means complete and only a few of the more than 100 presses have been installed, the first sheets of laminated material have emerged from the line. Construction of the new plant was begun by the Austin Co. of Cleveland early this year.

The new plant is replacing present General Electric facilities for manufacture of laminated materials at Lynn, Mass. It will consist of three buildings with the principal factory building comprising 235 thousand sq. ft. and it is expected to have an ultimate capacity of twice the company's present output. Provisions have been made for the manufacture of both high and low pressure lamination and fabrication of these materials.

SPI DIVISION WILL MEET IN CHICAGO

INDUSTRIALISTS of the low-pressure division of the Society of the Plastics Industry will hold their second conference and exhibit at the Edgewater Beach Hotel, Chicago, from January 23 to 26, inclusive. This is distinct from the National Plastics Exposition to be held beginning May 5, also in Chicago. Large, contoured products now made under low pressure methods will be on exhibit, such as boat hulls, plane fuselage sections, luggage, panelling, pre-fabricated house sections, and other reinforced products.

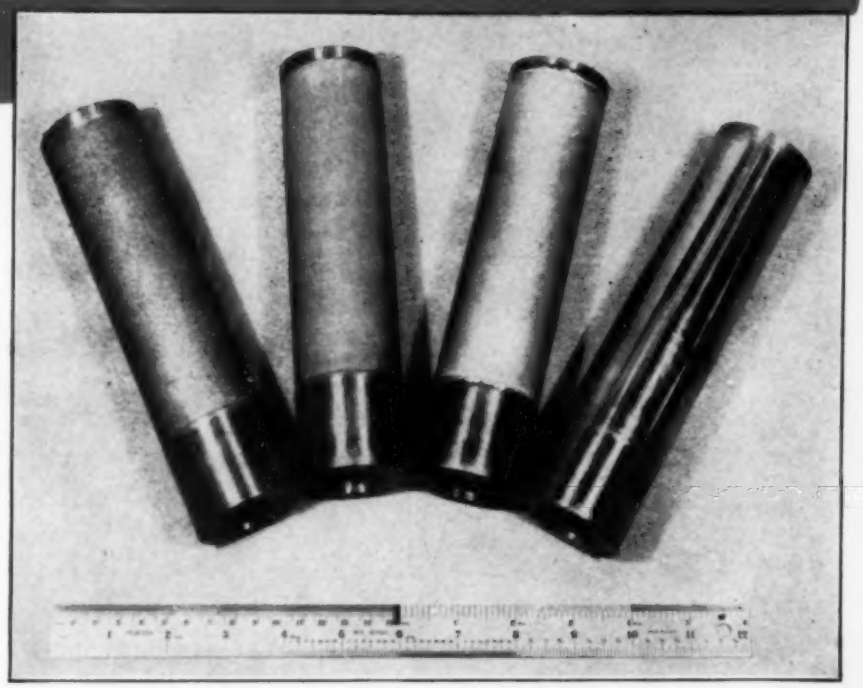
N.Y.U. CONDUCTS ADDITIONAL GRADUATE COURSES

GRADUATE courses in powder metallurgy, management of research and development, and surface finishes, are being conducted by the College of Engineering, Graduate Division, New York University. The course in management of research and development will be presented by various directors of research from industry, while the courses in powder metallurgy and surface finishes will be taught by Dr. C. G. Goetzel and Dr. M. A. Coler, respectively.

ENEMY PATENT INFORMATION ON FILE AT GEORGIA TECH

A WEALTH of technical information has been made available to Southeastern industry through the establishment at the Library of the Georgia School of Tech-

Welding and Metalizing COMBINED IN TWO NEW COLMONOY Processes



SPRAY WELD PROCESS
USING COLMONOY NO. 6

1. Sleeve, showing undercut and blasted surface preparation.
2. Sleeve, showing deposited overlay.
3. Sleeve, showing deposited Colmonoy after fusing in controlled atmosphere furnace.
4. Sleeve, showing finish ground surface.

NOTE: This is from an unretouched photograph.

THE RESULT? SMOOTH, UNIFORM OVERLAYS—
Free from Porosity and Fusion — Bonded to the Base Metal

Both of these new processes use metalizing practice to deposit a smooth, uniform overlay of Colmonoy No. 6. Then, because of the long "plastic range" of this wonder metal, the overlay can be bonded to the base metal either by acetylene torch, induction coil or in an atmosphere controlled furnace. The thickness of the overlay is easily controlled. You can apply as little as .010" or as much as .060" per side.

Colmonoy No. 6 outwears hardened steels by upwards of five times. It is extremely resistant to corrosion. (For example, its corrosion is only 5% that of stainless steel in all concentrations of sulphuric acid.) It has high red hardness. It is non-magnetic and non-sparking.

COLMONOY *Powder Weld Process*

Uses powdered Colmonoy and the Powder Weld Torch.

COLMONOY *Spray Weld Process*

Uses 1/8" plastic bonded rod of Colmonoy in your ordinary flame spray metalizing gun.

WRITE

for full information and step-by-step instructions for application.

WALL COLMONOY CORP.

SEVENTH FLOOR, FISHER BLDG. DETROIT 2, MICH.

nology at Atlanta, Ga., by the Alien Property Custodian of a complete file of enemy patents seized by the government during the war. Thousands of ideas for new materials, new processes and new products are contained in these patents which may be utilized by United States citizens on a non-exclusive royalty-free basis under reasonable licensing fees.

The abstracts cover mechanical-electrical patents and chemical patents in the first part of 4,450 pages covering some 37,000 patents and consist of such topics as bleaching and dyeing, motor vehicles, machinery, paper manufacture, plastics, radiant energy and textiles. The second part of 34 volumes comprises approximately 7,000 chemical patents grouped by fields of interest, including such subjects as ceramic materials, foods, fuels, textiles, pulpwood and paints.

NEW MERCK STREPTOMYCIN PRODUCTION STARTS

GREATLY increased supplies of streptomycin will soon be available from the new Merck & Co. plants at Elkton, Va., and Rahway, N. J., which have started to produce the drug on a large scale. The new Elkton plant is not yet in full production but expects to reach maximum output by the end of the year. Merck has informed the CPA that much larger supplies of the drug will be available for allocation this month.

NEW IRON POWDER PLANT IN MINNESOTA

IN A cooperative program a modern plant is being built on the Mesabi Iron Range of northern Minnesota for the conversion of iron carbonate slate to pure iron powder. Continental Machines, Inc., has contracted to operate the plant, which is being built by the state with funds appropriated from the tax on mining iron ore, administered by the Commissioner of Iron Range Resources and Rehabilitation. Stearns Rogers Mfg. Co., of Denver, Colo., are the contractors constructing the plant which will have an estimated capacity of 5 tons of iron powder per day. The conversion process was developed by the late Charles V. Firth at the Mines Experiment Station of the University of Minnesota.

In a continuous chemical process, susceptible to close control, the iron is dissolved out of the ore by acid, precipitated as crystals of iron sulphate and preferentially roasted to iron oxide of high purity. This product is then reduced to iron powder of controlled physical characteristics with a purity of over 99 percent.

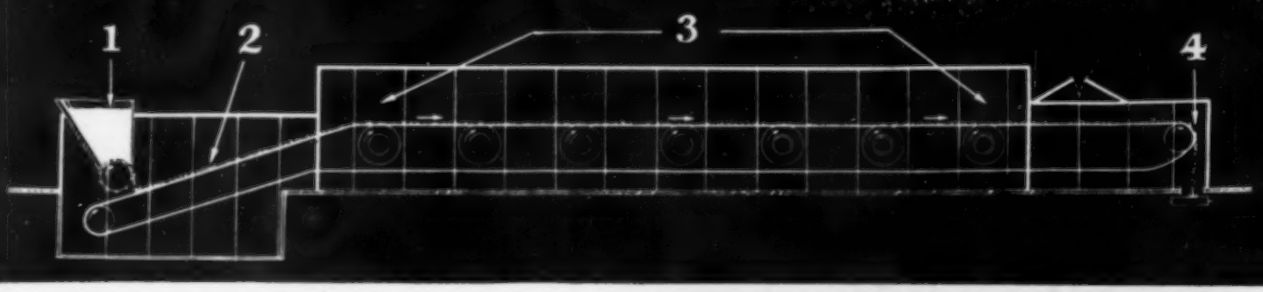
Continental Machines, Inc., has named John R. Daesen president of a new division, Iron Inc., to operate the plant and market the product.

COORDINATE LOCAL PROGRAMS OF N. Y. ENGINEER SOCIETIES

ORGANIZATION of the Engineering Societies Council of New York occurred recently. It is made up of delegates representing the local chapters of engineering, scientific and technical societies. The purpose of the new organization is to

ACCURATELY CONTROLLED DRYING OF PLASTICS SETS QUALITY IN

Continuous Conveyor System



The manufacturer seeking a method of drying plastics that will increase production and at the same time assure a uniformly high quality product, will find his answer in the Proctor Continuous Conveyor System. The answer to increased production comes in the fact that the system is a *continuous conveyor system, automatic in operation.* The answer to the quality of the finished plastics comes in the *accurate control* possible with this system. It is a known fact that the future usefulness of the raw plastic is set in the dryer. Proctor engineers have designed many systems for use in the drying of urea-formaldehyde, casein and soya bean plastics. In each case, *drying time* and *temperatures* are controlled to meet the specific requirements of the plastic being handled. The speed of the conveyor is regulated to affect drying time.

1. Approximately 12½ cubic feet of wet material in granular form is deposited in hopper of automatic feed. Uniform feeding is assured.

2. Material with moisture content of 69.5% (B.D.W.B.*) is loaded to depth of 1½" on conveyor which carries it through 8 drying units.

3. Temperatures within drying enclosure are graduated downward beginning at 230°F. in first unit and ending with 160°F. in the last unit.

4. Material is discharged with moisture content of 0.02% (B.D.W.B.). Capacity of dryer is 500 lbs. per hour (C.D.W.†).

*Bone Dry Weight Basis.

†Commercial Dry Weight.

Automatic feeding devices, developed by Proctor engineers, are in use with the dryers, controlling the amount of material fed to the dryer at all times. A typical installation showing a Proctor continuous drying system for synthetic resin is illustrated. If you have a plastics drying problem, don't hesitate, write today, giving as much information about your problem as possible.

P&S

enable the engineering profession in Greater New York to render a better coordinated program in the interests of the public and members.

The following officers have been elected: chairman, H. C. R. Carlson, ASME; vice chairman, H. P. Wall, ASSE; secretary, M. P. Davis, ASTM; and treasurer, H. F. Dart, IRE. Directors elected were: O. B. J. Fraser, AIME; E. J. Lyons, AIChE; W. F. O'Connor, ACS; C. S. Purnell, AIEE; H. J. Ryan, ASHVE; and E. M. Sherwood, ASM.

METALLURGICAL ENGINEERING ADDED AT DREXEL

New courses that will lead to degrees of bachelor of metallurgical engineering and master of metallurgical engineering have been established at Drexel Institute of Technology. The board of trustees has appointed an advisory committee on metallurgical engineering from industrial laboratories and plants.

Members of the advisory board include Dr. G. H. Clamer, president of the Ajax Metal Co.; William J. Diedrichs, metallurgist with the Autocar Co.; Francis B. Foley, superintendent of research for the Midvale Co.; Clyde B. Jenni, metallurgist for the General Steel Casting Corp.; Norman C. Mochel, manager of metallurgical engineering at the South Philadelphia Works of the Westinghouse Electric Corp., and Joseph Winlock, chief metallurgist for the Edw. G. Budd Mfg. Co. Prof. A. W. Grosvenor will direct the new courses.

READERS' VIEWS and COMMENTS

COOPERATION MADE PAPER

To the Editor of Chem. & Met.:

Sir:—I have noted with interest the article titled "American Made Paper for Your Cigarettes" in your June issue and can imagine that you had difficulty in clearing it for publication. But this would not seem to warrant the exclusion of pertinent developments which led the management to gamble on the construction of such a large plant.

The story as related was not brought to fruition technologically because of the courage and energy of one official of the company, but rather because of the efforts of the technical men associated with the company previous to the construction of the plant. The article is conspicuous in not mentioning their contribution.

As you know, I was research director from January 1932 until September 1939 when I left the company voluntarily. The commercial runs were conducted under my supervision as research director and the technique used was based upon a great deal of experimental work carried out by the research group. Original process patents upon which the plant design was based were issued to me as inventor between October 1935 and August 1940.

It is hoped that you will accept the above comments in the spirit in which they are offered.

Edwin P. Jones

Salinas, Calif.

PACIFIC PROCESS INDUSTRIES

TRENDS • EVENTS • DEVELOPMENTS

JOHN R. CALLAHAM, Pacific Coast Editor, San Francisco, Calif.

NEW PACIFIC DIVISION OF WYANDOTTE CHEMICALS

MANUFACTURING and distributing activities of the products of both the J. B. Ford and Michigan Alkali Divisions of Wyandotte Chemicals Corp., and of Natural Soda Products Co., are now being directed in the Pacific States by a newly organized Pacific Division of Wyandotte Chemicals Corp. with offices in the Central Tower Bldg., San Francisco. The new division will also solicit business on the new Wyandotte organic specialties and fine chemicals.

Charles O. Chesnut is general manager and also became president of Natural Soda Products August 1 on the retirement of Stanley Pedder. Manufacturing operations of this organization are at Owens Lake, Calif.

Field sales activities of the former J. B. Ford division (specialized cleaning compounds) will continue to be supervised by P. S. Spencer. Mr. Spencer will be sales manager of the newly organized Pacific Division and will continue to supervise the company's sales organization in the territories of Seattle, San Francisco and Los Angeles.

AGRICULTURAL DUSTS MADE BY DUPONT IN TACOMA

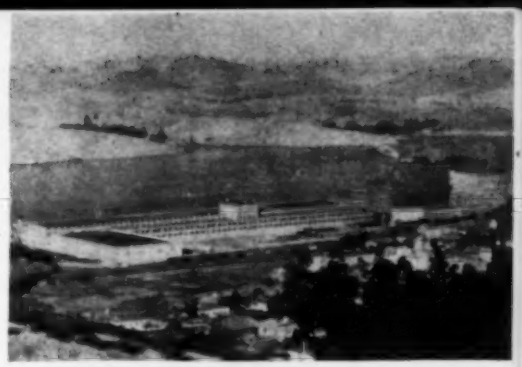
MANUFACTURE of agricultural dust mixtures containing fungicides and insecticides was recently initiated by the Tacoma, Wash., plant of E. I. du Pont de Nemours & Co. Built in 1925, the plant was purchased from Latimer-Goodwin Chemical Co. in 1944 and began operations under the Grasselli Chemicals Dept. of Du Pont, producing lead and calcium arsenates. The new dust mixing unit installation was completed last May.

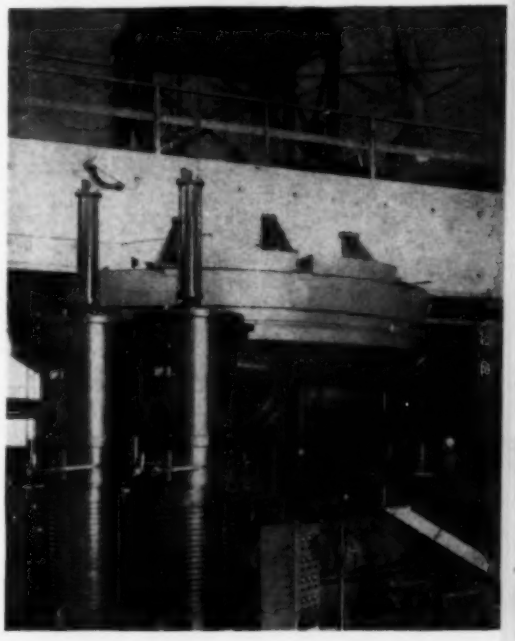
Active ingredients of the various mixtures made at Tacoma include copper compounds, DDT, rotenone, calcium and lead arsenates, synthetic cryolite, and various Du Pont fungicides. These dusts are used to control pea aphis and weevil, potato blight and leaf hoppers, onion thrips, cabbage worms and other diseases and insects affecting vegetable crops of the Pacific slope.

WYOMING TRONA PROJECT GETS UNDER WAY

CONTRACT for sinking a 1,500-ft. shaft to launch the trona development planned by Westvaco Chlorine Products Corp. near Marston, Wyo., was let during mid-July to a Boise firm, according to a statement made public by Senator Joseph C. O'Mahoney of Wyoming, at a cost of approximately $500,000. The work will be done for the chemical firm which has leased lands from the Union Pacific Railroad Co. with the intention, according to the report, of constructing a processing plant capable of handling 60,000 tons of trona annually for conversion into soda ash or for other uses. The contract calls for a 12-ft. concrete-lined shaft.

The Wyoming trona deposits were discovered on land owned by the Union Pacific in the summer of 1939 when the Mountain Fuel Supply Co. was drilling for natural gas west of the town of Green River, Wyo. They are reported to be tremendous in tonnage and to consist of nearly pure trona containing about 47 percet Na_2CO_3 and 36 percent $NaHCO_3$ (*Chem. & Met.*, Sept. 1941, p. 112).





Among the plants visited by engineers attending the western convention of the AIChE was the world's largest sugar refinery — that of the California and Hawaiian Sugar Refining Corp., Ltd., at Crockett, Calif. Delegates also saw the huge cyclotron nearing completion at the University of California. Steel plates across its top and on the side are part of the 4,000-ton electromagnets; 184-in. chamber is between copper-wound poles; at left are two vacuum pumps.

CHEMICAL ACTIVITIES INCREASE IN UINTAH BASIN

MOST active chemical spot in the Intermountain area at present is the Uintah basin and nearby territory in northeastern Utah and northwestern Colorado, including the Rangely oil field. Present activities include those of the American Kilsonite Co. of Bonanza, Utah Rock Asphalt Co. at Sunnyside, Utah Chemical & Oil Co. at Vernal, Adrian Nagelvoort in fossil resin extraction at Huntington, Uinta Oil Refining Co. at Jensen, and of the numerous oil firms in the booming Rangely field.

More than $1,000,000 has been spent since 1942 in industrial construction at the large gilsonite works at Bonanza, Utah, now owned jointly by Standard Oil of Calif. and Barber Asphalt Co. and known as American Gilsonite Co. Expansion activities are still under way (*Chem. & Met.*, Feb., 1946, p. 196). Utah Rock Asphalt

Western AIChE Meeting Proves Big Success

With a total attendance probably exceeding 700 and far above all expectations, the western regional convention of the American Institute of Chemical Engineers in San Francisco during August 25-28 goes down in history as one of the three largest conventions, national or regional, ever held by the Institute during its 38 years of existence. Informality and conviviality were conspicuous keynotes of the entire meeting.

Success of the meeting was best shown by the unusually large and attentive audiences at the technical sessions. Attendance at each of these approached 400-425, the capacity of the halls. Close to 200 persons attended the symposium on "Chemical Engineering Education in the West" on Sunday afternoon, the opening day. Approximately 425 persons were present at the "New Western Chemical Industries" symposium on Tuesday. All social affairs, ladies' programs and plant trips were over-subscribed. Approximately 85 ladies attended.

Some 130 persons from outside the 11 Western States attended the meeting, largely from New York, Texas, New Jersey and Pennsylvania. Other non-western states represented were Missouri, Ohio, Michigan, Massachusetts, Connecticut, Louisiana, North Carolina, Illinois, Tennessee, Indiana, Delaware and Oklahoma. Nine delegates represented Canada, Mexico, Colombia and The Netherlands.

Of the total estimated attendance, approximately 545 or 81 percent came from the West. Some 76 percent of this western representation came from San Francisco and the Bay Area, about 17 percent from Los Angeles and southern California, and 6 percent from the Pacific Northwest States of Washington and Oregon. Other western states represented, in order of delegates, were Colorado, Utah, Idaho and Nevada.

Co., Sunnyside, Utah, has increased its mining and mechanical processing of rock asphalt, a mixture of asphaltum and sand compressed by nature into rock form, which is largely used for road construction. The Sunnyside deposit is reported probably to be largest and richest of its kind known in the world. On Asphalt Hill just west of Vernal, the Utah Chemical & Oil Co. is reported to have a $50,000 pilot plant in operation to extract and process the low-sulphur bitumens from the vast deposits of bituminous sands. The firm, using a hot water flotation process, aims to produce 50 bbl. of oil daily and to process some of the bitumens into other industrial products. Fossil resins for the paint and varnish trade are being extracted from Huntington canyon coals by Adrian Nagelvoort through sink-float and solvent purification processes. (*Chem. & Met.*, March 1946, p. 177). Uinta Oil Refining Co. has expanded its plant at Jensen, Utah, on the banks of the Green River. Still largely unexploited are the resources of Coal Mountain west of Vernal, gas deposits in the Ashley dome east of Vernal, some 2 billion b.ft. of timber in Uintah forest, phosphate deposits, gypsum of the San Rafael swell, and the carnallite deposits near Moab.

Biggest development of the region, however, has been the spectacular growth of the Rangely oil field in Colorado. This field is now delivering close to 25,000 bbl. daily by pipeline to Wemsutter, Wyo., from where it is pumped to refineries of Utah Oil Refining Co. at Salt Lake City, Frontier Refining Co. at Cheyenne, the Texas Co. at Casper, Wyo., Wasatch Oil Refining Co. at Woods Cross, Utah, Perry Petroleum Corp. at Denver, and Idaho Oil Refining Co. at Pocatello. Utah Oil Refining Co. has to date received a major portion of the crude. The Texas Co. recently announced that it intends to close down its Craig, Colo., refinery capable of processing 1,500 bbl. daily and transfer activities to Casper, Wyo., where a $5,000,000 expansion has been announced. The shut-down is scheduled for the spring of 1947. Meanwhile, drilling is being continued to a rapid pace in the Rangely field although production is held down by limited pipeline capacity. The field is believed capable of ranking alongside the great producing oil fields of Texas and the Southwest.

CONTAINER FIRM PROGRESSES ON MAJOR EXPANSION

In an expansion program covering the next three years, Fibreboard Products, Inc., San Francisco, expects to spend some $24,000,000 at various locations. Biggest single item will be the erection of a new two-machine board mill and converting plant on the east bank of the San Joaquin River two miles east of Antioch. The project will add 200 tons daily to existing board mill capacities and will give regular employment to over 400 persons when the first unit is brought into production early in 1948. The plant will be known as the San Joaquin Div. of Fibreboard Products, Inc.

Second largest development in the expansion program is the construction of a new plant at Antioch for Glass Containers, Inc., a wholly owned subsidiary. This new plant, on which construction is already well advanced, is located on a 20-acre tract and will have an annual output of 36,000 tons of glass containers. It will provide regular employment for 200 persons. The firm already has a large glass container producing unit in Los Angeles.

Buildings and equipment are also being planned at Stockton, Calif., to increase the shipping container output of this plant by 75 percent and the carton output by 50 percent. Additions are being made to the carton and corrugated box department of the Antioch plant to increase finished goods output of these units by 50 percent.

ACETYLENE PLANT PURCHASED BY AIR REDUCTION

Purchase of the government-financed acetylene plant in Portland, Ore., by Air Reduction Sales Co., its wartime operator, has recently been announced. Purchase price was reported at $130,300. The plant, situated on 4.6 acres, was designed for a monthly production of 1,200,000 cu.ft. of acetylene. Buildings consist of two carbide storage and generator units, a two-story filling and handling structure, service building, desiccator house, and a gasholder with 5,000 cu.ft. capacity. Production equipment includes one horizontal three-stage acetylene compressor complete with cylinder filling manifolds, acid scrubber and pump, and acetylene purifier. The firm, with western headquarters in Emeryville, Calif., has operated plants at Emeryville, Portland, Tacoma and Seattle.

ALUMINA-FROM-CLAY UNITS CLOSED BY RFC

Word has been received that RFC ordered the shutdown of the experimental alumina plants at Salem, Ore., Laramie, Wyo., and Harleyville, S. C. The unit at Salem, using Oregon high alumina clay, was put in "standby condition" for Al_2O_3 production during July and will concentrate on production of fertilizer-grade $(NH_4)_2SO_4$ for the remainder of 1946. However, this unit, promoted by Columbia Metals Corp. but constructed and operated for the government by Chemical Construction Corp., for several weeks has been producing alumina that considerably exceeded the quality specifications for product to be used as cell feed in electrolytic reduction to aluminum metal. Technical feasibility of the Chemico process (see *Chem. & Met.*, Dec. 1945, pp. 108-9) is considered by persons familiar with the plant operations to have been quite successfully demonstrated; results of studies on economic feasibility have not been completed. For the remainder of the year and possibly well into 1947, the plant expects to produce 200-225 tons monthly of $(NH_4)_2SO_4$ for UNRRA and domestic agricultural uses.

The unit at Laramie, Wyo., however, was ordered closed just at the time when it was to begin initial operations. The Laramie process, largely developed by Monolith Portland Cement Co., uses sintered limestone, anorthosite and soda as raw materials and would produce Al_2O_3 as a byproduct of a process designed primarily

to improve quality of the cement raw material. For this reason, it has been generally held that the Monolith process had best prospects for immediate commercialization of all the experimental methods of producing reduction grade Al_2O_3 from non-bauxite raw materials. The plant, estimated to have cost $4,500,000 and originally scheduled to operate in the fall of 1945, had not been purchased by Monolith; its ultimate fate is still uncertain.

NUCLEAR ENERGY RESEARCH CONTINUED AT LOS ALAMOS

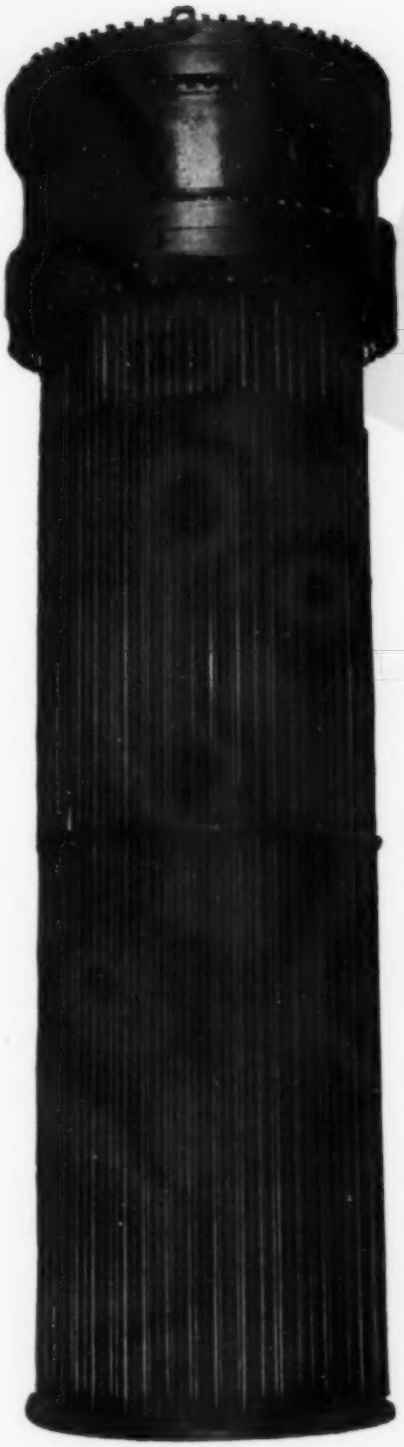
COMMENTING on the fact that a contract had just been signed to extend for another year the research work of the University of California at the Los Alamos Scientific Laboratory, President Robert G. Sproul stated that the University is keenly interested in the development of nuclear energy for peacetime uses. Attention now is to be given to pure research at Los Alamos. Announcement has been made that buildings and sanitary facilities at the New Mexico laboratory will be of permanent construction in the future. Work is to begin soon on 300 permanent houses.

The University of California has had charge of the Los Alamos project, where the atomic bomb was developed, since the inception of the plan at the beginning of 1943. Dr. J. R. Oppenheimer, nuclear physicist from the Berkeley campus, was director until Oct. 15, 1945, when he was succeeded by Dr. N. E. Bradbury. Meanwhile, increasing interest has been shown by western researchers to proposals that a source of nuclear energy and fission by-products be made available for industrial research and development in the West. Plans along such lines are now progressing.

NEW SUPER-CONDUCTIVITY DATA FOUND AT STANFORD

MAJOR new phenomena in physical chemistry have recently been discovered at Stanford University, Palo Alto, in the field of electrical super-conductivity, according to a recent report. Experimental studies of metal-ammonia solutions by Dr. R. A. Ogg, Jr., of the department of chemistry, indicate possible application in the transmission of electricity without loss due to resistance and in development of improved detectors of infrared light rays. Although many super-conductors are known, these have such properties only if their temperature is held to within a few degrees of —273 deg. C. However, Dr. Ogg's solutions, after rapid freezing, show the essential features of super-conductivity at temperatures as high as —85 deg. C. "One at least can now begin to wonder about the possibilities of super-conductivity," stated Dr. Ogg.

Use of the solutions in infrared detectors probably is much nearer, stated the report. The solutions, which are liquid ammonia solutions of alkali metals such as lithium, sodium and potassium and alkaline earth metals such as barium, calcium and strontium, would serve as the light-sensitive surface from which electrons are emitted when struck by infrared rays. Unique properties of the solutions are due to the fact that electrons are trapped in spherical micro-cavities of the liquids; two electrons can even occupy the same cavity to form "a disembodied chemical bond" without the



The many uses of G-Fin units and their advantages of design and construction are more fully described in bulletins which will be sent on request.

Why G-FIN is widely adaptable to many kinds of

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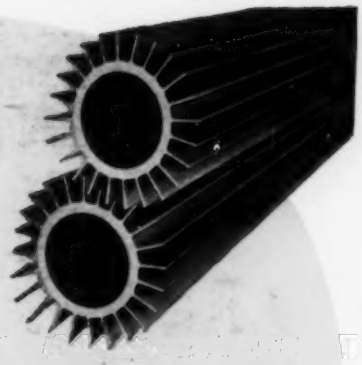
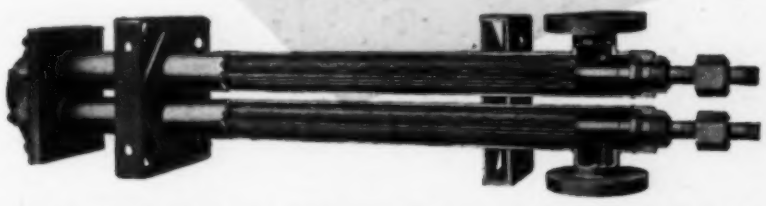
units





The G-FIN Element, originated 15 years ago by Griscom-Russell, has demonstrated the greatest range of usefulness of any heat transfer surface on the market.

These elements are used in more than 40,000 Twin G-Fin Sections serving as heaters, coolers, condensers and heat exchangers for a wide variety of liquids, vapors and gases. They are also extensively used in tank heaters, contactor bundles, and baffled units.

One reason for this unequalled adaptability of the G-Fin element is its longitudinal fins which provide six to eight times the external heat transfer surface of a bare tube. Another reason is that these elements can be applied to standard interchangeable sections which can be used for many different services. G-Fin elements have fully proven their dependability over long periods of service and under severe operating conditions.

THE GRISCOM-RUSSELL CO., 285 Madison Avenue, New York 17, N. Y.

GR-120

GRISCOM-RUSSELL

Pioneers in Heat Transfer Apparatus

presence of any atomic nuclei. Dr. Ogg's studies, begun independently about a year ago, are being continued under sponsorship of the Navy's Office of Research and Inventions.

LARGE ION EXCHANGE PLANT TO BE BUILT SOON

ANNOUNCEMENT was recently made by James D. Dole of pineapple fame that the Chemical Process Co., which he founded eight years ago in San Francisco, plans a $300,000 plant to produce synthetic resin ion exchangers. The new plant will be built on a 10-acre site in Redwood City, Calif., and will replace the firm's present small plant at Millbrae, now employing 20 persons, which has been in production since 1944 (see *Chem. & Met.*, Feb. 1946, p. 196).

One of the early workers in the field of sugar purification by ion exchange, Chemical Process Co. now has or soon will have its Duolite resins in the first large ion-exchange installations in the cane and beet sugar, corn sirup and pineapple juice industries. In the cane sugar field, certain tests indicate that some 250 lb. more sugar might be recoverable from the average of about 20 tons of cane sugar grown to the acre—an increase of 8 percent. A small cane sugar plant, now being built in Louisiana, will recover waste sugars by using resin ion exchangers. A large beet sugar refinery in California has decided to install a full-size recovery unit, while a pineapple firm plans to take the impurities out of pineapple byproducts and convert waste into sirup. The same process might possibly be applied to juices recoverable from California fruits.

Chemical Process Co. shares this field in a patent agreement with Dorr Co. and Infilco, Inc., each of which has the right to grant licenses on royalty in the United States and certain foreign countries. President of the San Francisco firm is James D. Dole. Dr. Gordon F. Mills is research director, while Dr. B. N. Dickinson has charge of sales and technical service to industry.

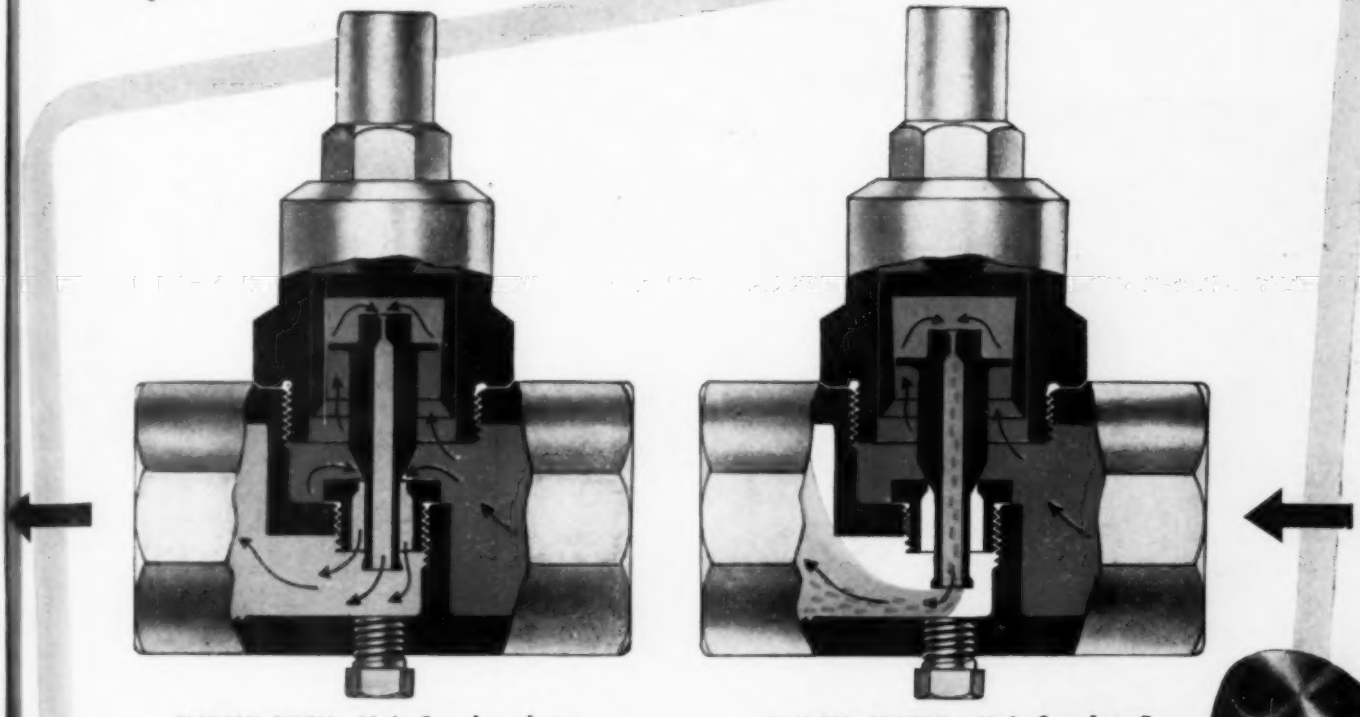
MAJOR REFINERY EXPANSION UNDER WAY AT CASPER

IN ORDER to provide equipment to make the highest quality gasoline as well as to meet expected volume increases, The Texas Co. is now expanding its Casper, Wyo., refinery. The products now manufactured include motor gasolines, diesel, kerosene, furnace oil and tractor fuel. Manufacture of these products will be continued and, in addition, after the new facilities are installed a full line of surfacing and asphaltic materials will be manufactured.

A new 10,000-BPOD crude topping and vacuum unit will be erected. The vacuum unit will supply a gas oil cut which, together with the gas oil from normal pressure flashing on the topping unit, will provide charge for a new 4,000-BPOD fluid catalytic cracking unit. The major portion of the crude to be processed will be from so-called sour crude fields and the proposed units will be designed to meet expected corrosion problems. In addition, a chamber-type polymerization unit will be erected and a liquid-phase Girbotol unit will be installed for H_2S removal. The present cracking unit will be rehabilitated

WHY YARWAYS GET EQUIPMENT

Hotter, Sooner



VALVE OPEN—Main flow through seat.

VALVE CLOSED—Main flow shut off.

There's a basic reason why the Yarway Impulse Steam Trap gets equipment hotter, sooner . . . and *keeps it hot.* It's this . . . As soon as steam is turned on, the Yarway trap opens wide and discharges air and condensate continuously until the system is cleared. Equipment is brought to working temperature in the shortest possible time.

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YARWAY IMPULSE STEAM TRAP

for running of sour crude. New asphalt and road oil manufacturing facilities will be provided. Treating equipment will be revamped and augmented to permit treating both gasolines and distillates to meet required product quality.

Actual installation of proposed facilities started in the early part of 1946 and as of July 1, 1946, the project is about 25 percent complete. It is expected that these facilities will be placed in operation the early part of 1947. Total cost of the project has been estimated at close to $6,000,000.

COOPERATIVE EDUCATION PLAN BEGUN BY FOOD MACHINERY

Introduction of a cooperative education program applicable to certain engineering students at Stanford University has been announced jointly by the University and the Food Machinery Corp., San Jose, Calif. The plan will enable a limited number of qualified students in the upper division of the school of engineering to add commercial engineering experience to their scholastic curriculum. Students participating in the program will spend approximately 91 weeks of intensive training in the Anderson-Barngrover Div. of Food Machinery Corp. in San Jose. The work-training schedule will be interspersed with the students' regular college engineering program. During the industry-training phase, which began during the summer quarter, students will receive instruction in the firm's pattern shop, foundry, sheet metal shop, machine shop, assembly department, service-sales department, engineering department, and one of the canneries using food processing equipment. Participants in the program will be paid while undergoing training at Food Machinery Corp.

KAISER BYPRODUCTS USED BY INSULATION PLANT

Utilizing byproducts from the Kaiser iron and steel plant at Fontana, Calif., the Mineral Wool Insulations Co. has announced a $100,000 building program to manufacture insulation material from blast furnace slag and coke. The company, expecting to get into operations by September, will have a plant capacity of 50,000 tons annually, with initial operations at about 20,000 tons. The finished product will be produced through processes recently acquired by American technicians from a survey of the German insulation industry, and the plant will be one of the most modern of its kind in the country. The firm will manufacture such products as baked batts, paper wrapped blankets, and granulated wool for the building construction industry. President of the new firm, which will maintain offices in Los Angeles and San Francisco, is Harvey H. Head, formerly with Kaiser Co., Inc. Vice president and chief engineer is Charles W. Hawthorne, formerly with Johns-Manville Co.

WEST'S ENGINEERS INSUFFICIENT FOR INDUSTRY NEEDS

Western colleges and universities have evidently been unable to supply sufficient chemical engineers to meet the demands of the region's industries, according to a survey conducted among western members

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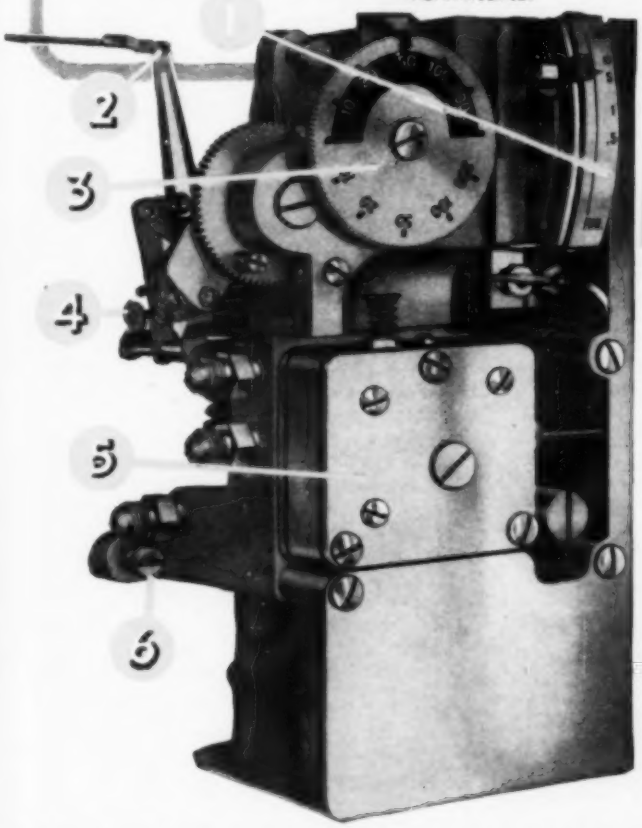

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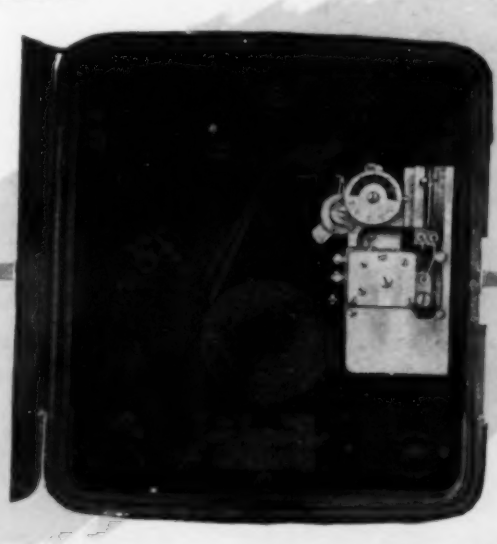

THE NEW

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M-40

CONTROLLER

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of the American Institute of Chemical Engineers by the Northern California Chapter. Results of the survey, conducted by Mott Souders, Jr., of Shell Development Co., were disclosed and discussed at the education symposium presented at the western convention of the AIChE in San Francisco, August 25-28. Nearly 200 persons were present at the symposium, of which approximately 30 represented most of the colleges of the 11 Western States.

Western industry has been forced to use chemists in place of chemical engineers in many instances, the survey showed, and more than 50 percent of the chemical engineers at present in the West obtained their degrees from eastern universities; more than 75 percent of those with advanced degrees graduated from schools in the East. Still another survey showed that 26 western firms (representing 8 petroleum companies, 9 large chemical firms and 15 smaller companies) had a total technical personnel of about 3,500 of which some 400 represented chemical engineers. Annual accession of chemical engineers for these firms was indicated to be about 100.

Although most colleges of the region offer courses and degrees in chemical engineering, the University of Washington and California Institute of Technology are the only ones whose chemical engineering curricula have been accredited by the American Institute of Chemical Engineers. The questionnaire to western AIChE members showed a marked sentiment in favor of greater stress in chemical engineering curricula on unit operations and fundamentals and disfavor on emphasizing shop work and laboratory chemistry. There was very strong favor toward a greater emphasis on the humanities; this sentiment seemed to increase proportionately with age of the engineers.

GENEVA SPEEDS STEEL PLANT RECONVERSION

A SECOND battery of byproduct coke ovens and a second blast furnace have already resumed operations at the Geneva, Utah, steel plant of Columbia Steel Co., according to a recent report. Only one of the four batteries of coke ovens and one of the three blast furnaces had been kept in limited operation since war orders were filled. Three of the nine open hearth furnaces were ready to go by the first of August. The plate mill is expected to resume rolling in the reasonably near future.

Meanwhile, construction work on the company's new $25,000,000 cold reduction sheet mill and tinplate mill at Pittsburg, Calif., has gotten under way and actual erection of buildings was expected to start in September. When completed next year the new mill will be capable of producing some 500,000 tons of steel sheets and tinplate. This will mark the first time cold reduced sheets and tinplate have been manufactured on the Pacific Coast. Orders already placed for equipment include those for two continuous electrolytic cleaning lines, continuous pickling lines, 14 hot-dip tinning units, one continuous electrolytic tinning line and a sheet galvanizing line.

Anticipating an expansion of steel fabricating industries on the Pacific Coast, Columbia Steel Co. has filed application for a

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rate of $8 per net ton on finished steel from Geneva to all Pacific Coast points from San Diego to Seattle. Present commercial rates, since termination of war emergency rates, are $12 to Pacific Coast ports from San Diego to Portland and $13.20 to Seattle.

PLYWOOD-ADHESIVES FIRM CHANGES HANDS

CONTROL of the $6,500,000 Harbor Plywood Corp. of Hoquiam, Wash., has been sold to a group of Pacific Coast and eastern underwriters, according to a company release in August. Earl L. Kelly, president of the First California Co. of San Francisco, becomes chairman of the board of directors. E. W. Daniels and M. W. Paterson of Hoquiam will remain as president and secretary.

The corporation, with main plant and offices at Hoquiam, had a 1945 sales volume of more than $7,500,000. The plant has a rated annual capacity of 120,000,000 sq.ft. of ⅜ in., three-ply board and has three dryers, two cold presses and hot presses for manufacture of waterproof exterior grades. In fact, Harbor Plywood Corp. was the first firm in the Pacific Northwest to install a hot press and to make exterior type fir plywood by the hot process; this was in 1935. Since that time, the firm has become one of the largest plywood glue producers in the Northwest, with a production estimated at close to 200 tons monthly. Producing exclusively for its own plant requirements, the firm uses a patented process developed by its own engineers for the manufacture of synthetic resin adhesives.

STARCH-GLUCOSE PLANT AT THE DALLES—CORRECTION

APPLICATION for permission to build a $300,000 (previously reported at $900,000, *Chem. & Met.*, June 1946, p. 170) starch and glucose plant at The Dalles, Ore., has been approved by CPA for Northwest Chemurgy Coop., Inc. The project, for which $150,000 was earmarked for construction and $150,000 for equipment, would produce starch and glucose from off-grade wheat or potatoes for distribution in the baking and ice cream trades. Meanwhile, the firm is expanding operations at Ellensburg, Wash., to include production of glucose as well as starch from cull potatoes.

WESTERN INDUSTRY CONTINUES EXPANSION MOVES

AMONG the expansion moves announced last month by western chemical process and equipment firms, the following are illustrative of the increasing industrial integration of the region.

Rubber Products—The Converse Rubber Co. of Malden, Mass., proposes to erect a $1,000,000 factory at San Bernardino, Calif., to supply industrial rubber goods to the expanding industry of southern California.

Petroleum Products—Tidewater Associated Oil Co. has awarded to Bechtel Bros. McCone Co., San Francisco, the contract for construction of a crude distillation unit and control building, stills,

tanks and other facilities at its Avon, Calif., refinery. Cost has been estimated at about $2,500,000.

Atomic Testing—Contract for construction of a missile test unit at the Atomic Proving Grounds at White Sands, near Alamogordo, N. M., has been awarded by U. S. Army Engineers, Albuquerque. Cost is placed at $967,200.

Paper Board—Puget Sound Pulp & Timber Co., Bellingham, Wash., has awarded the contract for construction of a $500,000 paper board plant at Bellingham, where the firm has a large mill producing sulphite and other pulps and alcohol from sulphite mill liquors.

Gilsonite—Recently capitalized for $60,000, the Ouray Producing & Refining Corp., Salt Lake City, has announced plans for construction of a small gilsonite processing plant to use material derived from deposits in the Uintah basin of Utah.

Chemical Education—CPA approval was granted during July for the construction of a $730,000 chemistry building to be erected on the Berkeley campus of the University of California. The present 50-year old structure is claimed to be inadequate in view of the anticipated 20,000 student enrollment this fall.

Pulp Mill—Crown Zellerbach Corp., San Francisco, has let the contract for approximately $750,000 for the first phases of the firm's $11,000,000 expansion program at Camas, Wash. Contracts will be let later for a kraft bleach plant at Camas.

Research—Construction is now ready to begin on the research and engineering building for Gates Rubber Co., Denver, one of the largest industrial firms between the Rocky mountains and the Pacific Coast. Cost of the three-story structure is estimated at $260,000.

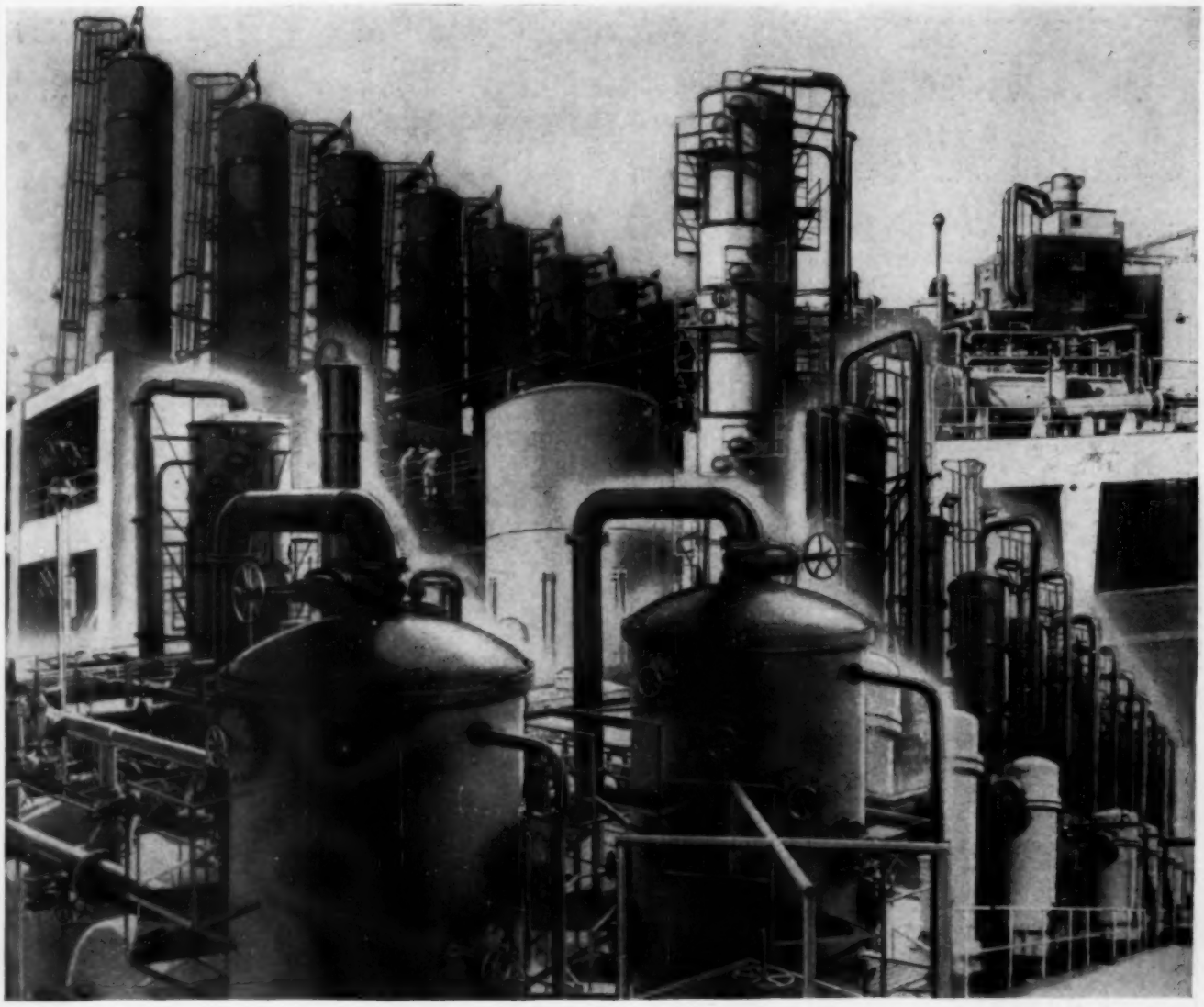
Glucose—Northwest Chemurgy Coop., Wenatchee, Wash., is expanding operations of its Ellensburg, Wash., plant to include the production of glucose from potato starch. The plant has recently gone on a year-round operating basis.

Valves—A completely new, modernly-equipped plant for the precision manufacture of cast and forged steel valves and fittings is now being built in Los Angeles by Kerotest Pacific Co., which recently took over the Security Valve Div. of Security Engineering Co., Inc., of Whittier, Calif.

Paper Mill—Recently-organized West Tacoma Newsprint Co., owned by 14 western newspapers, is reconverting the former Cascade Paper Co. plant at Tacoma into a newsprint producer. A new mill is being reconstructed to produce 50 tons of newsprint daily, with later expansion to 80 tons daily. Production is expected to begin in early 1947.

Natural Gasoline—W. J. Cannon & Associates of Denver proposes to enlarge its natural gasoline absorption plant at Trinidad, Colo., for production of liquefied petroleum gases. Cost is estimated at $750,000.

Insecticides—Chipman Chemical Co. proposes to build a plant on a 6.5-acre site in San Francisco to produce arsenical and chlorate weed killers, agricultural insecticides and fungicides. The firm now has a similar unit in Portland.



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NEWS FROM ABROAD

BRITISH GOVERNMENT ENCOURAGES INDUSTRIAL PLANTS TO SWITCH FROM USE OF COAL TO OIL

Special Correspondence

WHATEVER THE new National Coal Board will do to raise the efficiency and productivity of the nationalized colliery industry, it now seems certain that all fuel needs during the coming winter cannot be met out of British coal production. Stocks, even now dangerously low, are bound to decline further, and fuel consumers will have to go on using inferior or unsuitable grades. No wonder then that the government encourages the use of alternative fuels and industrialists are eager to respond to this call. In the chemical trades, unfortunately, there is little scope for the temporary switch-over to fuel oil recommended and subsidized by the government. Moreover boilermakers are inundated with inquiries for conversion equipment, so that for lack of proper heating installations alone the coal saving by use of oil fuel next winter cannot but be small.

Leading chemical manufacturers fear the coal shortage will continue for some time, and as supply of unsuitable grades has caused considerable difficulties during the war they are by no means unwilling to give oil a fair trial not just as a temporary expedient but for long-term substitution. Imperial Chemical Industries Ltd., it was officially stated, is considering not only the conversion of many coal burners but use of oil fuel in its £40,000,000 expansion scheme. Installation of oil burners would involve a large capital outlay, but the company is now paying £3,500,000 more for its coal and coke than it did immediately before the war, and a saving on this extra charge plus economies in boiler plant labor would to some extent offset any additional cost of new plant.

Meanwhile the Chancellor of the Exchequer has decided to remove the import duty for gas oil and heavy fuel oil from next year; until then he will pay a subsidy to British consumers to relieve them of the cost of the import duty while still in force. This "will afford an appreciable relief against higher operating costs of oil-burning plant compared with coal-burning plant" and is hoped to result in conversion from coal to oil to the maximum extent possible. Informed circles doubt whether this concession is going far enough. Without duty fuel oil still costs nearly twice as much as coal giving the same amount of heat, and lower import prices and distribution costs are needed to reduce the cost of fuel oil further.

But even if chemical manufacturers, irrespective of cost differences, switch over

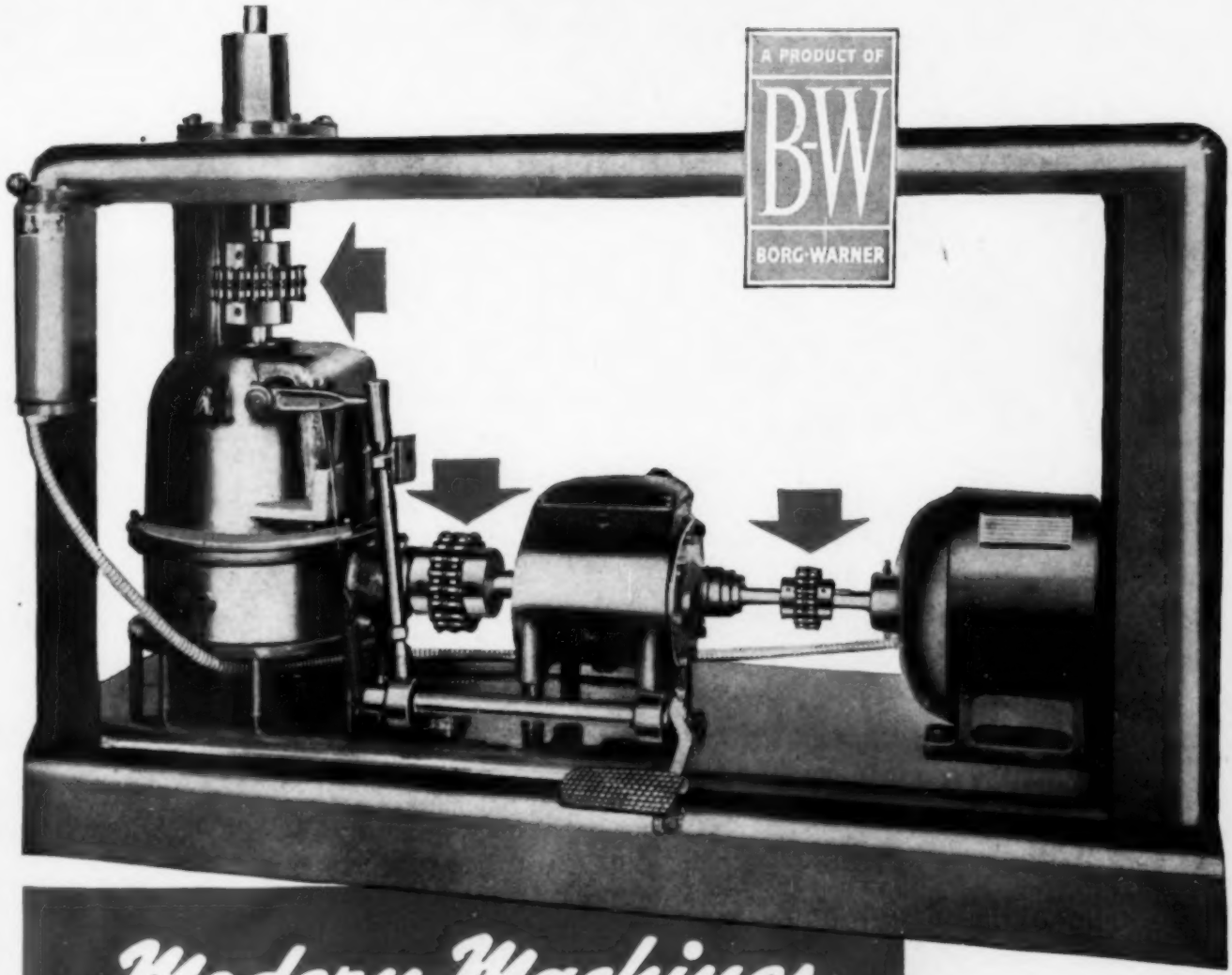
to oil fuel to avoid stoppages of work next winter, the coal intake is likely to remain substantially above prewar levels. Gas and coke manufacturers who alone account for nearly one-quarter of Britain's coal consumption expect this year to exceed their prewar consumption by 20 percent. The resulting additional output of byproducts is being absorbed by the chemical trades without any effort. On the contrary, like coke and gas, coal-tar and derivatives remain in short supply. Larger deliveries of phenol to plastics makers have cut supplies available for pharmaceutical manufacturers. Coal-tar and pitch for road making and building can be provided only by reducing exports.

The position is not different for many other chemical raw materials. Increased orders for whiting from the Ministry of Food were met only by lowering allocations to the paint industry. Linseed oil is, under a new scheme, reserved for building, transport and essential industrial paints; makers must use the 4,000 tons of linseed oil a month supplied to them in such a way that the government can count on specified quantities of paints becoming available. Even in the case of such a comparatively unimportant material as plaster of Paris, manufacturers have been asked to give preference to dental and surgical requirements, cutting down on supplies for building purposes. In the case of glue and gelatine control over distribution, only recently removed, has been re-imposed.

In all these instances the fundamental problem is that the supply does not meet the demand and that some consumers must go short until production is extended. The unexpectedly high home demand has forced the government to go slow with its export promotion schemes. For copper, lead and zinc the slight export concessions introduced in the middle of June were cancelled only seven weeks after they were made, and in the case of glycerine, exported mainly under a commitment entered towards the United States last November, the government has been criticized for not foreseeing the present shortage. In general, however, the process of decontrol continues. Restrictions on the use of fertilizers, rubber, and tanning agents are among those ended or relaxed in the past few months.

USE OF SUBSTITUTES

Persisting shortages of essential raw materials are, of course, giving a stimulus to substitution measures. Soapless detergents, for instance, will soon become available in larger quantities; until then exports will be limited to token shipments. Some of these specialties designed to meet the demands of special consumers (e.g., for washing milk bottles, plates and spoons, or for big laundries) are now being made in greatly increased quantities, and it is hoped to extend their use by developing special types to prevent corrosion, against mold and pests, and in connection with drugs. Meanwhile they are fulfilling a useful task in helping to economize in soap and fats. The shortage of paint oils is proving a great incentive for makers of substitute solvents for paint pigments, and there are many other instances of commodity shortages directly stimulating chemical research. Though manufacturers are unwilling to publicize



Modern Machines Deserve Morse Couplings

Western Manufacturing Company of Detroit uses Morse Flexible couplings at all shaft-connecting points in their Model 9000-E transmission and secondary speed reducer.

Morse Flexible couplings—in either roller chain or silent chain design—are available in a wide variety of ***stock sizes.*** Data on larger sizes on request.

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their plans, many of them seem to count on a prolonged continuation of present shortages. One crucible manufacturer contemplates the production of insulating refractories, demand for which is expected to profit from the need for fuel economy and will develop other "carbon specialties."

British Glues and Chemicals Ltd. is paying attention to "materials previously regarded as unsuitable for gelatine and glue manufacture" and Distillers Co. prepares for "alternative raw materials to take the place of industrial alcohol." Bakelite Ltd. is installing new equipment for making vinyl plastics and urea molding materials, not previously made by the company, and Dufay-Chromex Ltd. has developed a new low-density product consisting of a multitude of resinated paper cells bonded between two thin skins of practically any material which combines very low weight with extreme strength and is recommended for a good many construction materials. In all these instances the wish to evolve alternatives for materials in short supply is the mainspring of new activities.

FOREIGN TRADE

In view of existing shortages in the home market it remains to be seen whether the government will demand from chemical manufacturers in future the same concentration on exports as in the past. The holiday period naturally caused a slight decline in production and shipments, but with fuel and raw material shortages in the face of an expanding home demand for essential purposes the export drive will, at least in some sectors of the chemical industries, have to take second place behind vital domestic needs. Chemical trade between the United States and Great Britain shows a substantial balance in favor of the former. Chemical manufactures from U.S.A. figures in the British trade returns for the first half of 1946 with £2,247,762 as compared with £4,927,155 in January-June 1945 when war supplies greatly swelled the total and £2,834,560 in the whole of 1938. It thus seems certain that, even if U.S.-British trade declines further, the United States will remain Britain's leading supplier of chemicals. British chemical imports from all sources in January-June 1946 totalled £8,725,230 against £11,454,897 in the first half of 1945 and £13,612,694 in the whole of 1938.

In the British export trade in chemical products the United States are much less prominent. In January-June 1946, £606,890 worth of chemicals were shipped to U.S.A. against £1,536,987 in the first half of 1945, and £941,224 in the whole of 1938, while all British chemical exports amounted to £31,695,027 as compared with £16,443,792 in the first half of 1945 and £22,279,790 in the whole of 1938.

INTERNATIONAL CHEMISTRY CONGRESS IN PARIS

REPORTING from Paris, the McGraw-Hill World News says that for the first time since before the war, an International Congress of Industrial Chemistry will meet in Paris from September 22 to 28. This will be the twentieth such meeting sponsored by the French Societe de Chimie Industrielle, and will bring to

gether delegates from 38 countries, including the United States, France, Great Britain, USSR, Italy, Switzerland, Holland, Belgium and Luxemburg.

Under the direction of Robert Bienaime, president of the Societe de Chimie Industrielle and honorary president of the Association of French perfumers, the Congress will be divided into twenty sections covering all phases of industrial chemistry. Not only new technological developments but also factory management problems, laboratory techniques, scientific and industrial organization, and marketing problems (both national and international) will be discussed. By early August over 200 papers had been received by Jacques Baudry, the Congress' Secretary General.

Following four days of meetings and conferences, the Congress delegates will be escorted on sightseeing tours and also on visits to factories and research institutes in France. Among the visits scheduled is an exploration of the Pommery champagne company's wine caves at Reims.

The Societe de Chimie Industrielle, an organization founded in 1917 with the primary purpose of spreading chemical knowledge and bringing together chemists from scientific laboratories and from the industries for their mutual benefit, had sponsored an International Chemical Congress ever since 1921 until the outbreak of war in 1939. The 1939 reunion, scheduled for Warsaw at the end of September, was regretfully cancelled. Nevertheless the Society—which managed to hold itself together throughout the war—published clandestinely, while under the German occupation, some of the papers prepared for that Warsaw Congress.

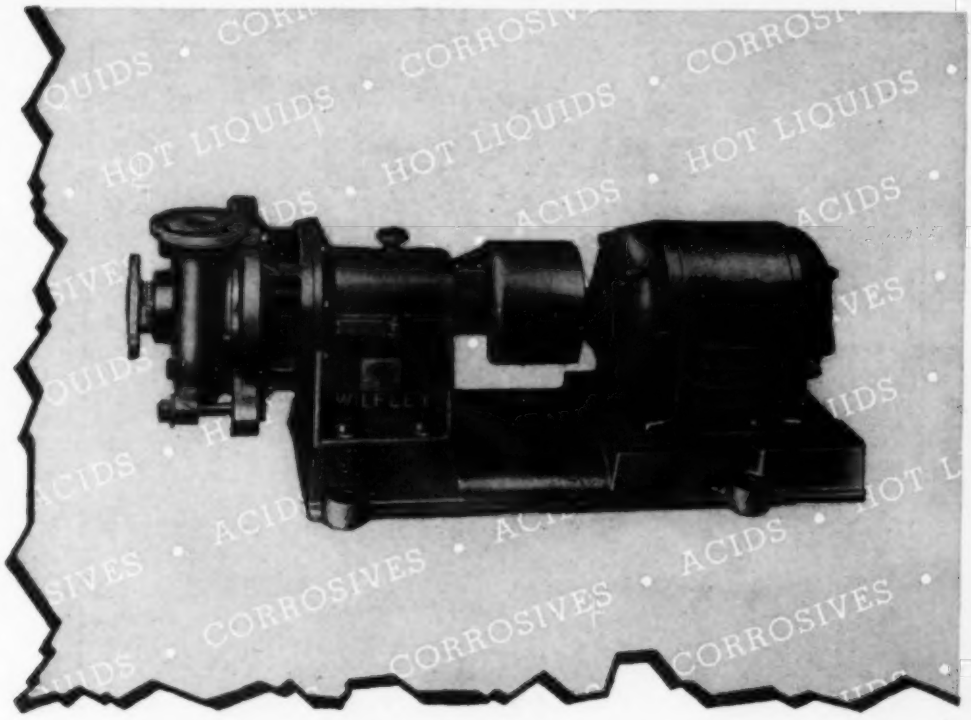
Papers from the present Congress will be available with considerably less difficulty. Inquiries for them should be addressed to the Secretariat of the Congress, Maison de la Chimie, 28 rue St. Dominique, Paris VII.

MEXICO IS DEVELOPING DRY ICE INDUSTRY

Although Mexico has what is admittedly the richest and largest deposit of carbon dioxide gas so far known, its dry ice industry is in its infancy. Drilling in search for oil made in 1921 in the northern part of the state of Veracruz brought the discovery of an extremely rich CO_2 deposit. Up to now, however, only one well is exploited, by an American-owned company, the Compañia Mexicana de Hielo Seco, S. A., which is the only producer of dry ice in the country. The Hielo Seco company took the deposit over in 1929, after the Texas Co. had abandoned it in 1928—after unsuccessful attempts to get a 100 percent pure product.

The Carbono well (the location was named the name of the gas) has a daily capacity of seven million cu. ft. of gas, flowing at a pressure of 70 kg. per sq. cm., which compares favorably with the output of the much smaller American wells, such as those of the Imperial Valley, whose production varies between 50,000 and 200,000 cu. ft. per well.

Present capacity of the plant is 1,000 tons of dry ice monthly—a figure which



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can be increased to 5,000 tons as soon as equipment still unavailable can be installed. Present production now reaches some 12 tons a day of 100 percent pure dry ice. The company claims that its dry ice is purer than that produced in the United States, and is currently exporting part of its production to Corpus Christi, Tex.

According to the statistics made by the Tax Department of the Federal Finance Ministry, production of dry ice of the plant was 5.332 kg. in 1944, 1.163.996 kg. in 1945, and for the first four months of 1946, 517.389 kg. Output is gradually increasing but still is far from full capacity, due mainly to lack of sufficient demand for this new product and to transportation difficulties.

So far, the manufacturing company delivers over 50 percent of its output to another company, the Liquid Carbonic de Mexico S. A., which converts it into liquid in the plants it owns in Tampico, Mexico City and Monterrey. The liquid, bottled in steel containers, is sold to soft drink manufacturers. However, Hielo Seco plans to develop use of dry ice as a refrigerating product. To overcome the fundamental objection to shifting to the new product, the high cost of the specially equipped railway cars and trucks, it is preparing a financing scheme which will make these vehicles more accessible to prospective users of its product.

Even now dry ice is used as a refrigerating product by a growing number of industries. The Stille Laboratories use it in Mexico City for the manufacture of penicillin, a maker of ice cream bricks in Monterrey has adopted it, and a growing number of meat and fish packers on the Gulf Coast are turning to it for shipping of their perishable products to the interior of Mexico.

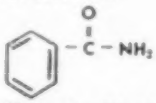
Manufacture of dry ice in solid state enjoys the tax franchise for ten years granted to new and necessary industries by the Mexican Government. However, when it is liquefied, it has to pay 60 centavos (13 cents) per kg.—in this case paid by Liquid Carbonic Co. Manufacturer's price to distributor or large consumers-direct distribution to the latter will start next spring—is 200 pesos (about $40) per ton at Tampico, or 250 pesos delivered at Mexico City or Monterrey.

Interior view of Mexican plant in the State of Veracruz which is now producing 12 tons a day of 100 percent pure dry ice from a rich CO_2 deposit

Hooker Research Presents Three New Chemicals with a Useful Future

Among the many new chemicals Hooker Research has developed during the past year, the three listed here have proved of such interest to research chemists and in such different areas that we feel warranted in bringing them to your attention again. Should a scanning of the condensed description cause a desire for more detailed information on any of them, we shall be glad to send you Technical Data Sheets giving more comprehensive physical and chemical characteristics. The coupon below makes it easier for you to request additional information.

BENZAMIDE

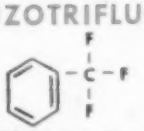


Molecular Weight	121.0
Melting point	125°C
Boiling point	290°C
Flash point	164°C
Fire point	185°C

Benzamide (Amide of Benzoic Acid) is a white, free-flowing monoclinic crystalline material. It is soluble in alcohol, acetone, hot water, and hot benzene; slightly soluble in cold water and other solvents.

Its physical and chemical properties suggest its possible application in the field of organic synthesis, including dyestuffs, pharmaceuticals and plastics. It is compatible with a limited number of resins including cellulose acetate and nitrocellulose with which it forms a firm transparent film.

BENZOTRIFLUORIDE

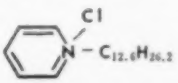


Molecular Weight	146.1
Freezing range	-28.5° to -29.5°C
Boiling range (ASTM, 98%)	2.5° including 101°C
Refractive index, n20/D	1.4145±.0005
Specific gravity, 15.5°/15.5°C	1.197±.001
Flash point	12°C

Benzotrifluoride is a water white liquid with an aromatic odor. It is completely miscible with most organic solvents. Thermal stability is excellent and under nitration or chlorination the CF_3 group is strongly meta directing.

A study of possible applications indicates that Benzotrifluoride may be of value in several industrial fields; dyestuffs, dielectrics, medicinals, insecticides, or other organic chemical synthesis.

LIQUID LAURYL PYRIDINIUM CHLORIDE



Molecular Weight (ave. active ingredient)	292.3
Specific Gravity, 15.5°/15.5°C	1.00
Freezing point	-1°C
Boiling point	100°C
pH	7.0

Liquid L. P. C. is a 30% water solution of Lauryl Pyridinium Chloride. It is a purified, non-staining, odorless, practically colorless product. It is miscible in any proportion with water and water miscible solvents as lower alcohols, acetone, and glycols. It is a cationic surface-active quaternary ammonium derivative possessing strong bactericidal and bacteriostatic properties.

Its germicidal, detergent, and penetrating characteristics suggest many possible applications in the field of detergent antiseptics, in the preparation of fungicides and disinfectants, and in textile finishing compounds. It also has possibilities in the preparation of cosmetic cotton, sterile bandages and other bactericidal or germicidal specialties.

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GERMAN CHEMICAL OUTPUT RISES IN U. S. ZONE

OVER-ALL production of chemicals in the U. S. Zone in Germany stepped ahead again in May, with the industry operating at 28 percent of estimated current capacity, according to a report by U. S. occupation officials. Fertilizer output was up all along the line—in cyanamid, phosphates and potash. After reaching a postwar high in April, production of soda ash fell back 6 percent in May to 4,500 metric tons. Calcium carbide was practically unchanged, but in two other basic inorganic chemicals—caustic soda and sulphuric acid—there were monthly gains. In addition to soda ash, crude coal-tar was one of the few important chemicals to record a decline in May—8 percent below April.

PAPER MILL BEING BUILT IN RUSSIAN UKRAINE

A LARGE paper mill to employ 10,000 workers is under construction in Zhidachev, Drogobych Region of the Ukraine. Covering an area of over 100 acres, the mill will have 14 paper and cardboard machines and an auxiliary factory to process the timber. A heat and power plant working on natural gas fed from the Dashava gas deposits will supply the mill's power needs. The river Strij will be dammed to provide water for the power plant and the mill. Projected daily output is set at 190 tons of newsprint, 170 tons of writing paper and 160 tons of cardboard. In addition, the mill will be able to produce large quantities of ledgers and other stationery items.

NEW SUPERPHOSPHATE MILL IN OPERATION AT RIGA

A LARGE, modern superphosphate mill that is annually to supply the farm fields of the Baltic republics with 180,000 tons of fertilizer has just been put into operation in Riga, the Latvian capital. The first enterprise to be launched in that republic under the new Russian five-year plan, it is completely mechanized and turns out much more fertilizer with a smaller number of workers than mills of this type did before the war.

NEW METHOD CHANGES COLOR OF STAINLESS STEEL

A METHOD of changing the color of stainless steel by adding several elements to the alloy has been evolved at the Stalin Steel Institute in Moscow. Academician N. T. Gudtsov, under whose supervision this work is being conducted, told the Russian press that the steel thus treated acquired a golden hue. It melts well and is suitable as a decorative material for architectural and sculptural purposes. The use of this colored steel will be of considerable economic value since it will require no protective coating. The new steel is now being tested for resistance to corrosion.

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GERMAN CHEMICAL INDUSTRIES

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Vinyl Chloride, Polyvinyl Chloride, Chlorinated Polyvinyl Chloride, and Bristles, Cane and Fibers. I. G. Farbenindustrie, Leipzig Area—This report describes the following: The plant apparatus, raw material, process, and uses of monomeric vinyl chloride at Schkopau; the continuous polymerization of vinyl chloride at Schkopau; the batch polymerization of vinyl chloride at Bitterfeld; chlorinated polyvinyl chloride at Bitterfeld; polyvinyl chloride synthetic bristles and cane at Wolfen; and chlorinated polyvinyl chloride filament and staple fiber at Wolfen. Flowsheets and photographs for the above processes are shown. (W. L. Wood; PB 19269; Jan. 1946; 37 p.; M. 50¢; P. $3.)

Flowsheet for Chlorine Plant—This document consists of a flowsheet and descriptive list of apparatus indicated thereon of I. G. Farben's chlorine plant at Leverkusen. (I. G. Farbenindustrie; PB 24929; Mar. 1946; 5 p.; M. 50¢; p. $1.)

Drawings of: Sodium Hypochlorite Flowsheet; Plant of Building 214; 7 Meter Mercury Cell; 9 KA Switch—These drawings are of the I. G. Farben 7-m. horizontal mercury cell chlorine plant at Hochst. Included are a diagrammatic flow chart of equipment of the entire process, a building plan, detail drawings of individual pieces of equipment such as a nine-kiloampere switch for the electrolysis current, an alarm cutout, a mercury pump (rated capacity not given), layout of cell and decomposer. Lists of material, translated into English accompany some of the detail drawings. Most of the special electrical equipment is listed as products of Voight and Haeffner A. G., Frankfurt. For chlorine storage at this plant, two 60-ton and six 13-ton tanks were placed in a bombproof shelter which was supplied with compressed air by single stage compressors from another portion of the operation. The flowsheet is labeled "Chlornatron." This sodium hypochlorite is the final product of the plant. The drawings were all prepared by the U. S. Industrial Chlorine Commission. (I. G. Farbenindustrie; PB 19685; June 1943; 3 p.; M. 50¢; P. $1.)

Operating Data and Costs of I. G. Farbenindustrie A. G. Chlorine Plants—This document comprises the cost accounting sheets of I. G. Farben's chlorine and chlorine byproducts manufacture at all their plants. The dates covered vary from 1939 to 1944. (I. G. Farbenindustrie PB 24930; 1939-1944; 90 p.; M. $1; P. $6.)

High Explosives: Manufacture of Nitroguanidine. Ninth Partial Report—This is a translation of a written description of the process for the manufacture of nitroguanidine as

CONCRETE . . . with oil dressing, is, you might say, not in good taste. Above you see original concrete floor under tanks carrying stearic and oleic acids. The effect of these chemicals is neither appetizing, aesthetic nor economical as regards the floor's life expectancy. In addition, absorption of fats and oils has caused the concrete to swell and soften.

. . . and here is the same location after the old, deteriorated concrete was replaced with an ATLAS Floor of Oil-proof brick, bonded with Atlas KOREZ cement. This ATLAS floor, bedded on a concrete foundation, thrives on daily rounds of sulphuric, stearic and oleic acids . . . with boiling water as a chaser.

These views, in Eastern edible oils plant, show "Before" and "After" ATLAS Construction

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In a corn syrup refinery, the destructive effects of sugar syrup, organic acids, solvents and oils, are nullified by this ATLAS floor. Note concrete under piers is covered with Atlas ZEROK—acid and alkali proof coating.

In this dye manufacturing plant, muriatic and sulphuric acids, alkalis and other corrosives must be reckoned with. The floor under the filter presses is of ATLAS acid-proof brick, joined with Tegul-VITROBOND acid-proof cement.

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carried out by Dynamit A. G. The statement was prepared by Dr. Walther Schnurr, a director of Dynamit A. G., Christianstadt. (Walther Schnurr; PB 16665; May 1945; 2 p.; M. 50¢; P. $1.)

Separation of Hydrocarbons by Selective Adsorption—This is a brief report of an extensive study made by the author of the separation of hydrocarbons by adsorption. The method, he says, can be applied technically for testing and evaluating gasolines, diesel oils, crude oils, and fractions. In German. (Gunter Spengler; PB 19391; Jan. 1945; 1 p.; M. 50¢; P. $1.)

Oval Wheel Meters—Oval wheel meters are used in all instances where absolutely correct and quick metering of volumes is required. The function and design of this oval wheel gear meter is fully described in this sales catalog. The meters are used in large chemical plants for measuring aggressive viscous, and poisonous light and heavy substances; in storage, transport and sale plants for measuring all sorts of power fuels and lubricating oils; in stationary internal combustion engines and marine engines for continuously controlling fuel consumption; and in aeroplanes, motor cars and railway motor cars for ascertaining fuel consumption and contents of fuel tanks. The meters operate in working temperatures ranging from −50 up to 200 deg. C., for pressures up to 100 atm. and rates of flow from 2 to 600,000 l. per hr. The catalog contains numerous diagrams, photographs, and charts, and descriptions of dials and recording and indicating instruments. (Bopp & Reuther; PB 4799; n.d.; 42 p.; M. 50¢; P. $3.)

Production of Acrylonitrile at Leverkusen Plant of I. G. Farbenindustrie—This report supplements previous information on the production of acrylonitrile from acetylene and hydrocyanic acid. Photographs and brief explanations are given of the hydrocyanic acid generator and the upper part of the reactor. A flowsheet of the reaction system is shown and a diagram and a brief explanation given of the recovery of the acrylonitrile. The composition of the cuprous chloride catalyst is noted. (A. Cambron; PB 19678; Jan. 1946; 10 p.; M. 50¢; P. $1.)

New Technical Applications of Acetylene—This report is based on a translation of a paper outlining the work of Dr. J. Walter Reppe of I. G. Farbenindustrie. Processes, reactions, examples, equations and uses are discussed under the headings of vinylation, ethynlation, carbonylation and cyclic polymerization. (D. C. Evans, PB 18953; 1935-1939; 177 p.; M. $2; P. $12.)

Pulping of Beechwood With Nitric Acid at Wolfen near Leipzig—The process for the manufacture of wood pulp with nitric acid may be outlined briefly as cooking with dilute nitric acid, neutralization and cooking in the digester with soda lye, followed by removal from the digester, chlorination, refining with strong soda lye, and bleaching. Nitric acid used for cooking is waste acid from dyestuffs manufactured in the Farben factory, conveyed to the pulping plant in tank cars. Liquid chlorine and sulphur dioxide are also received in tank cars from the Farben factory. At the end of the process the pulp is brought up from 1 to 4 percent on a suction filter. The greater part of the pulp immediately after passing the last filter is brought up to 50 percent concentration by a high pressure press. It is then cut up into flocks, and conveyed away. The remainder, about 10 tons a day, is passed over a paper machine where it is made into creped paper with a dry weight of 35-40 gm. per sq.in. The machine runs at a speed of 70 m. a min., and the moisture content of the sheet is about 6 percent. The dry crepe is sent away for the

manufacture of cellulose acetate whereas the wet flock is used at once for the manufacture of cuprammonium rayon and staple fiber. Pulp analyses and cost of production are given. Because of difficulty of disposing of waste liquors, an evaporation plant was built. After evaporation to 40 percent, the liquor is sent away to the Farben factory, where it is burnt to a low temperature to give a mixture of active carbon and sodium carbonate, which is sold for use in a metallurgical process. (A. M. Malcolm, PB 18906; June 1945; 13 p.; M. 50¢; P. $1.)

The Production of Tetrahydrofuran Intermediates—The information contained herein was obtained during the interrogation of Dr. Dorer of the I. G. Farbenindustrie plant at Ludwigshafen, May 28, 1945. Tetrahydrofuran is produced as an intermediate for other syntheses. The principal uses have been as a monomer for a polymeric synthetic lubricant and for butyrolactone which is a relatively high boiling ketone used as a solvent. An intermediate in the production is butandiol-1,4 which has been used in the laboratory preparation of a polymer for a nylon substitute. The formulas for the production of the tetrahydrofuran starting with aqueous formaldehyde, acetylene and the catalyst are given. Formulas are also given of the nylon-substitute process starting with hexamethylene diamine-1,6 and phosgene. Attached to this report is the 42-p. report in German of the nylon substitute "Polyurethane" by Dr. O. Bayer, Leverkusen-I. G. Werk, Sept. 24, 1941. (F. H. Roberts, PB 12635; June 1943; 47 p.; M. 50¢; P. $4.)

I. G. Farbenindustrie A. G., Leverkusen, Germany—The purpose of this survey was to investigate uses, manufacturing processes, costs and other pertinent facts concerning a group of inorganic and organic chemicals. The chemical compounds and chemical processes investigated were: (a) Barium compounds, (b) carbon and chlorinated carbon compounds, (c) ceramic colors and fluxes, (d) activated charcoal, (e) chlorine, sodium hydroxide, and hydrogen, (f) chromium compounds and processes, (g) chromizing of steel surfaces, (h) fluorine and fluorine compounds, (i) hydrazine hydrate, (j) hydrogen chloride, (k) lithopone, (l) oxygen, (m) sodium compounds, (n) sulphur-chlorine compounds, (o) titanium compounds, (p) vanadium pentoxide, (q) zinc compounds, (r) zirconium compounds. The following organic chemicals were investigated: Phenol, diphenyls, diisocyanates, tannigans and tanning agents, amines, chlorinated hydrocarbons, piperidine, rubber accelerators, rubber antioxidants and resins. Processes, flowsheets and production details are given. (L. C. Turnock and F. R. Lowdermilk, PB 6687; Aug 1945; 78 p.; M. $1; P. $6.)

The Production of Acetaldehyde, Acetic Acid, Acetic Anhydride and Acetone From Acetylene at the Bunawerke, Schkopau—Description is given of plant and processes, including raw materials, yield and factors of production. Flowsheets and diagrams are included. (W. L. Wood, PB 18910; Nov.-Dec. 1945; 25 p.; M. 50¢; P. $2.)

The German Fischer-Tropsch Process—This typewritten report covers the Fischer-Tropsch method for production of synthetic fuels. The synthesis requires two volumes of hydrogen to one of carbon monoxide. The Germans used the water gas method to produce these gases using a catalyst to convert the gases to the proper 2:1 ratio. They also used the methane oxygen method which gave the required 2:1 ratio more directly. German commercial synthesis used a cobalt catalyst which produced gasoline with a low octane rating. However, there was another process using an iron catalyst which produced gasoline with a higher octane rating. The end product contained C_3 and C_4 hydrocarbons. The remaining liquid consisted

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of gasoline, diesel oil, heavy oil and wax. Percentages depended upon synthesis methods used. Attached are flow diagrams showing the methane-oxygen process, catalyst production and cobalt catalyst reduction. Also attached are diagrams showing sections of the normal and medium pressure reactors. (Ernest Cotton; PB 12613; 1946; 16 p.; M. 50¢; P. $2.)

Kali-Chemie, Rhenania Phosphat Werke, Brunsbuttelkoog—Examination of this works shows that the production of a basic phosphate fertilizer by sintering phosphate rock with soda ash and sand has been technically and economically successful. The process is one requiring careful control and experience in operation. Many different types of raw phosphate rock can be used and from 90 to 95 percent of the phosphorus pentoxide content converted into a form soluble in ammonium citrate. The product sells in Germany at the same price per cent phosphorus pentoxide content as superphosphate. Full details of raw materials of the process and the plant are given. Table and flowsheet are included. (J. R. Howes and F. M. Lea, PB 18913; Aug. 1945; 19 p.; M. 50¢; P. $2.)

Oils and Fats Industry—In Germany the general tendency in oil-milling is double or sometimes treble expelling followed by solvent extraction whereby the oil content of the seed is reduced to 1 percent or lower. No new designs of expellers were seen, but Fritz Miller, Esslingen-Neckar, is developing a large machine having an output of 150 tons every 24 hr. as compared with the 47-72 tons in the same time given by the largest expellers they manufacture at present. Extraction by both batch and continuous processes as in operation, the tendency being for the latter process to displace the former. In the refining of oils the neutralizing, bleaching and deodorizing operations were carried out on conventional lines. In the hydrogenation of oils and fatty acids, nickel formate was the catalyst in general use, the main reason given for its selection being the ease with which it can be reduced. Batch autoclaving at pressures ranging from 12-40 atm. has largely replaced Twitchelling for fat splitting but there was no evidence that any attempt had been made to carry out the process in a continuous manner. A catalyst such as zinc oxide is employed only at the lowest pressure. All edible oils are treated for lecithin recovery, one of the main uses for lecithin at present being as an emulsifier in margarine. Carotene is obtained from palm oil by extracting a solution of palm oil soap with benzine. In the extraction of carotene from carrots, the carrots are digested with a small amount of caustic soda and then with an edible oil. Moisture is removed in a vacuum dryer and finally the oil is expelled from the dried material, any residual oil remaining after the expelling treatment is extracted with benzine. During the war synthetic glycerides prepared from synthetic fatty acids were used to the extent of 100 percent of the fat in margarine, and 80 percent of the margarine so produced was supplied to the German army and navy. The production of synthetic acids by air oxidation of gatsch from the Fischer Tropsch process appears to have increased very considerably during the war. A flow sheet of the process at the Markische Seifen Industrie is included. The OXO process for the manufacture, from Fischer Tropsch olefins, of fatty alcohols which are ultimately sulphated to give detergents, is an extremely interesting development especially in view of the fact that the cost of the alcohols is not a great deal more than the cost of the synthetic acids. Although up to the time of this report, alcohols had only been made on a 1,000 tons a year scale in a pilot plant, a commercial plant capable of producing 10,000 tons a year is practically ready for operation at Ruhn Chemie. A brief history of the plants visited and description of their products and processes are given. Composition of prewar and wartime products, includ-

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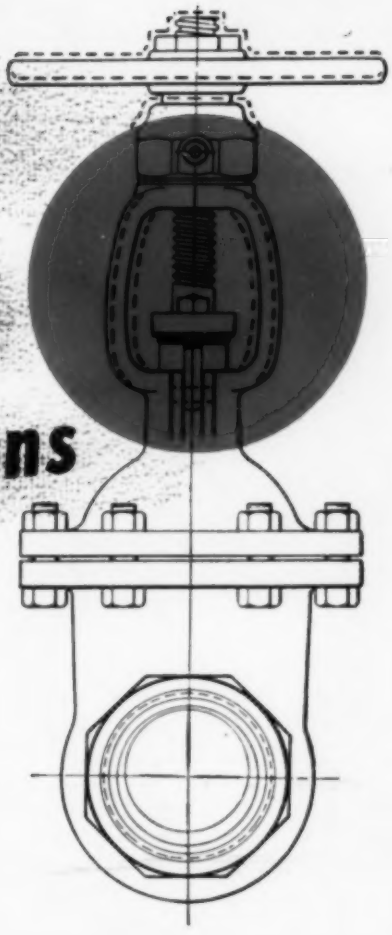

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ing unit ration soap, are given. (C. Vis and others, PB 18911; Aug.-Sept. 1945; 57 p.; M. $1; P. $4.)

Review of the German Patent Literature Relating to Synthetic Rubber—This report of the polymer research branch surveys what is hoped to be the complete German patent art on diolefin polymers and copolymers of rubber-like properties. It discusses (1.) Mass polymerization: Polydiolefins; reduction of time requirements of polymerization reaction; butyl rubber type rubbers; polyolefins (Vistanex Oppanol); modifiers; processing; stabilization. (2.) Emulsion polymerization: Early work; postwar development; copolymerization; modifiers; interrupting polymerization (short stopping). (3.) Processing. (4.) Compounding and vulcanization; Tables of compounding and vulcanization recipes; plasticizers, extenders. (5.) Rubber-like and plastic masses; polysulphide condensation products; polyvinyl compounds; vegetable and fish oil condensation products. (6.) End uses; adhesives; substitutes for rubber, alata and gutta-percha; coatings; hard rubber. Throughout the discussion are references to a table of German patents. This table gives the inventor or assignee, patent number, date of application and date of publication. Photostatic copies of all of the patents given in the list are on file in the Office of the Assistant Rubber Director for Research and Development of Synthetics. In addition, a large number of photostats of German patents on resinous vinyl and acryl polymers not incorporated in this survey are on file. (Frederick W. Breuer, PB 9676; 1943; 39 p.; M. 50¢; P. $3.)

The Production of Fluorine (U-Stoff) and Chlorine Trifluoride (N-Stoff)—This report is the result of the author's investigation of the German fluorine and chlorine trifluoride plant at Falkenhagen and is based on information received from its technical managers. It contains a full description of the working procedures for both chemicals, apparatus used, physical properties and possible uses. N-Stoff is a highly active incendiary. Attached is a collection of plans of the plant, machinery and apparatus. (Hans R. Neumark, PB 16838; Aug. 1945; 96 p.; M. $1; P. $7.)

Scholler Wood Sugar Plant at Holzminden—Ordinarily the plant operates on wood and uses 1,750 metric tons (calculated on the oven dry basis) per month of sawdust and shavings of coniferous woods from which there can be obtained either 300,000 liters of alcohol, or 250 tons of dry yeast. The species used are mostly pine, spruce and fir. Up to 1943 the plant produced only ethyl alcohol. In 1944 it produced 1,500,000 liters of alcohol and 237,000 kg. of dry food yeast. The following brief outline of the process as carried out at Holzminden is presented. Wood is charged in a finely divided state into a tall cylindrical vessel called a percolator. Hot dilute sulphuric acid is forced down through the wood under steam pressure. By this means, a portion of the cellulose is converted to sugars, which are in solution in the liquid drawn off from the bottom of the percolator. Fresh acid is now forced through the wood remaining in the percolator, and this repeated 19 or 20 times. The final result is that all of the cellulose content of the wood is converted to sugars which are drawn off in solution, and the lignin remains in the percolator. The sugars in solutions are converted into alcohol by growing yeast under such conditions that the yeast converts the fermentable sugars to alcohol, or the conditions of yeast growth may be so regulated that the yeast cells increase tremendously, using the sugars as food, and no alcohol results but only an increase in the quantity of yeast. Instructions for carrying out a percolation are shown in a table included in the report. Detailed descriptions of plant equipment and process, as well as data concerning the factory at Holzminden are given. Sketch of centrifuges is also presented. (C. Greaves, PB 18941; Nov. 1945; 1 p.; M. 50¢; P. $2.)

Phosphoric Acid vs. Materials of Chemical Plant Construction—Part III

Here is the final portion of a three-part symposium in which typical corrosion resistant materials have been evaluated for phosphoric acid service. For next month, we have a special report on materials of construction for handling molten sulphur and sulphur vapor.

DURIMETS T AND 20

D. E. JACK

The Duriron Co.
New York, N. Y.

THE PROBLEM of corrosion in handling phosphoric acid can generally be considered in two phases, first, the production of the acid, and second, its use in industry. In both phases, stainless Type 316 has been used with considerable success but should be considered as a "borderline" application. There have been sufficient failures to warrant the use of alloys containing greater percentages of particularly nickel and molybdenum reenforced with copper. Durimet T (22 Ni, 19 Cr, 2 Mo, 1 Cu) and Durimet 20 (29 Ni, 20 Cr, 2 Mo, 4 Cu) have fulfilled this requirement. In some of the most severe services, it is anticipated that still higher alloy contents may give a sufficiently longer life to justify the additional cost.

In the manufacture of phosphoric acid from phosphate rock, the fluorine content is of material importance. The phosphate rock in the United States varies in fluoride content from 0.3 to 2.0 percent. The fluorine content of the phosphoric acid, therefore, is such that in most cases high-silicon iron is not recommended. Durimets T and 20, however, have given excellent service in such processes. The need for this additional corrosion resistance is accentuated by the abrasive action of the gypsum slurries with the phosphoric acid.

Industrial use of pure phosphoric acid in such services as metal cleaning, oil refineries, food and pharmaceutical industries presents a somewhat different application depending on where and how it is used. In the pure form, Type 316 stainless gives excellent service but in many cases the introduction of other chemicals and salts places this alloy again on the "borderline." In these cases the Durimet alloys have given excellent results and, therefore, are widely used. The additional protection afforded from the higher alloy content when compared with the small additional cost, has resulted in many installations where possibly Type 316 would have been satisfactory. In fact, in some of these installations, Type 316 sheet tubing has been used with very good life, but pumps, agitators and valves, where corrosion may be more rapid, has resulted in Durimet's being specified. In practically all of these services, the high-silicon irons have proved to be very satisfactory.

Durimet T and Durimet 20 are available from practically all manufacturers of such equipment as pumps, valves, agitators, tank outlets, and other items normally produced from castings. Durimet T is available in rolled bar form.

NICKEL, NICKEL-ALLOYS

W. Z. FRIEND

International Nickel Co.
New York, N. Y.

USE OF nickel and the nickel alloys, Monel, Inconel, and Ni-Resist, with phosphoric acid is generally limited to the relatively pure acid derived from phosphorus vaporization processes (blast or electric furnace). Crude phosphoric acid produced by the treatment of phosphate rock with sulphuric acid usually contains ferric salts in an amount sufficient to make the solution highly oxidizing and consequently corrosive to these materials under most conditions.

Monel has useful resistance to unaerated pure phosphoric acid solutions of all concentrations at temperatures up to about 220 deg. F. At higher temperatures corrosion is usually appreciable, although there is some indication that in very strong acid such as tetraphosphoric containing 85 percent P_2O_5 resistance is adequate up to 350 deg. F. In phosphoric acid solutions, corrosion of Monel is usually increased considerably by a high degree of aeration particularly in the concentration range of about 10 to 50 percent H_3PO_4. The results of laboratory tests of Monel are given in Table I.

Nickel and Inconel are resistant to phosphoric acid solutions of all concentrations at atmospheric temperature. Their corrosion rates are increased somewhat by a high degree of aeration. Hot concentrated solutions of the pure acid are very corrosive to both nickel and Inconel. The results of laboratory tests are incorporated in Table I. Inconel, because of its chromium content,

Table I—Laboratory Tests of Monel, Nickel, and Inconel in Pure Phosphoric Acid

Conc., % H_3PO_4 by Wt.	Temp., Deg. F.	Duration, Days	Corrosion Rate, Unaerated (Aerated), In./Yr. Monel	Nickel	Inconel	Ref.
8.4	Room	½	..... (0.020)	..... (0.074)	.....	(1)
10.3	176	1	..... (0.135)	.....	.....	(2)
25.0	176	1	..... (0.069)	.....	.....	(2)
25.5	203	1	0.004 (0.048)	.....	.....	(2)
50.8	176	1	..... (0.048)	.....	.....	(2)
57.0	Room	27	0.0006	0.0005	0.0007	(3)
57.0	220	2	0.003	0.22	0.64	(3)
85.0	203	1	0.004	0.55	.....	(2)
90.4	Room	27	0.000	0.000	0.000	(3)
90.4	220	2	0.003	0.29	0.84	(3)
% P_2O_5						
84	140	2	0.0003 (0.0014)	0.013	0.0001 (0.000)	(4)
84	248	2	0.037 (0.036)	.....	0.000 (0.0003)	(4)
84	356	2	Gain (0.088)	0.049	Gain (0.25)	(4)
85	480	2	0.22	1.45	1.0	

Table II—Laboratory Tests of Ni-Resist (Type I) in Pure Phosphoric Acid

Conc., % H_3PO_4 by Wt.	Temp., Deg. F.	Duration, Hr.	Velocity Ft./Min.	Corrosion Rate, Unaerated (Aer), In./Yr.	Ref
5	86	20	15.5	0.066 (0.11)	
5	190	20	15.5	0.28 (0.36)	
15	86	20	15.5	0.052 (0.084)	
15	190	20	15.5	0.32 (0.49)	
25	86	20	15.5	0.043 (0.072)	
25	190	20	15.5	0.51 (0.51)	
% P_2O_5					
84	140	48	0.0	0.002	(4)
84	248	48	0.0	0.031	(4)
84	336	48	0.0	0.016	(4)

Table III—Plant Corrosion Tests in Phosphoric Acid Solutions Used for Surface Treatment of Steel

Test 1: In solution containing 1.5 percent H_3PO_4; agitated with live steam; 190 deg. F.; 51 days duration.
Test 2: In solution containing 12 percent H_3PO_4; agitated with live steam; 70-212 deg. F.; 230 days duration.
Test 3: In solution containing 50-58 percent H_3PO_4; 225-230 deg. F.; 300 hr. duration.

	Corrosion Rate, In./Yr.		
	Test 1	Test 2	Test 3
Monel	0.007	0.013	0.018
Nickel	0.013	0.018	0.027
Inconel	0.0002	0.002	0.023
Ni-Resist (Type 1)	0.053	0.056	.....

will frequently have useful resistance to crude phosphoric acid solutions at temperatures close to atmospheric, but not at more elevated temperatures (Table V).

The austenitic cast nickel-iron alloys, Ni-Resist Type 1 (14 percent Ni, 6 Cu) and Ni-Resist Type 2 (20 percent Ni), are usefully resistant to phosphoric acid solutions only at atmospheric temperature and when unaerated. Because of its copper content, the Type 1 alloy is usually somewhat more resistant than Type 2. Corrosion rates are given in Table II.

Monel is commonly used for tanks, heating coils and other accessories handling phosphoric acid solutions used for the surface treatment of steel and other metals. The results of a number of corrosion tests in such solutions are given in Table III. In

Table IV—Plant Corrosion Tests in Manufacture of Phosphoric Acid by Electric Furnace Process[5]

A Submerged in crude phosphorus sludge; phosphorus storage tank; reducing conditions; 140-158 deg. F.
B Submerged in 5-15 percent H_3PO_4; overflow from phosphorus settling tank; reducing conditions (sol'n. was sat'd. with P); 140-158 deg. F.
D Submerged in 85-95 percent H_3PO_4; launder of electrostatic precipitator No. 1 acid plant; oxidizing conditions; 176-266 deg. F.
D Submerged in 85-85 percent H_3PO_4; launder of electrostatic precipitator No. 2 acid plant; oxidizing conditions; 176-194 deg. F.
E Submerged in 75-80 percent H_3PO_4; acid storage tank; oxidizing conditions; 122-167 deg. F.
F Exposed to gas, principally N_2 and O_2 containing small proportion phos. acid mist and traces fluorine compounds; gas outlet electrostatic precipitator No. 1 plant; 185-212 deg. F.
G Exposed to gas, principally N_2, CO_2, and O_2 containing small proportions phos. acid mist and fluorine compounds; gas outlet electrostatic precipitator No. 2 plant; 185-212 deg. F.

	Corrosion Rates, In./Yr., For Conditions Above				
	Monel	"o" Mone	Nickel	Ni-Resist (Type 1)	Ni-Resist (Type 2)
A	0.001	0.000	0.001	0.000	0.000
B	0.005	0.001	0.005	0.010	0.025
C	0.050	0.10	0.25	0.45	2.0
D	0.010	0.005	0.15	0.025	0.35
E	0.025	0.005	0.050	0.025	0.10
F	0.025	0.010	0.025	0.10	0.10
G	0.050	0.050	0.050	0.10	0.050

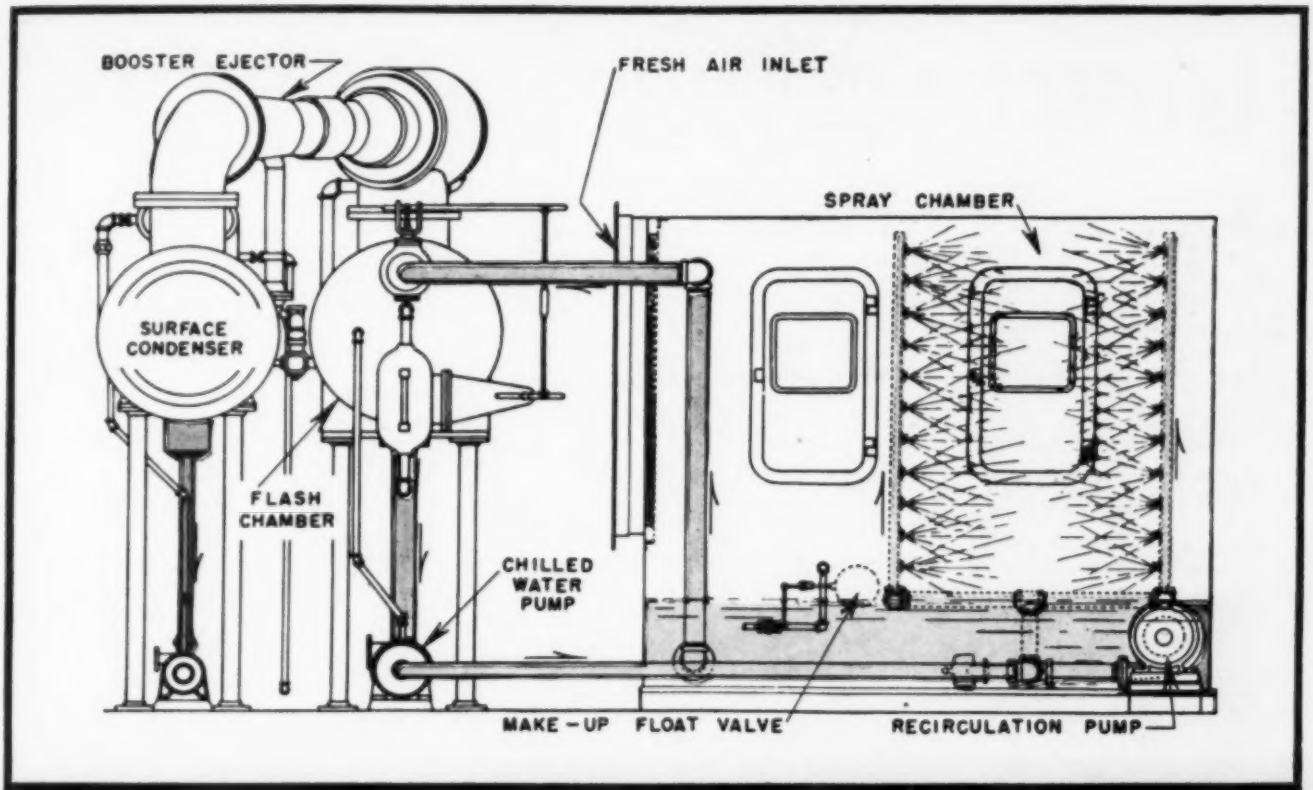

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Table V—Corrosion Tests in Crude Phosphoric Acid Solutions From Acid Treatment of Phosphate Rock

Test 1: Plant test in approx. 38 percent H_3PO_4 containing fluorine compounds, iron, and small amount of sulphuric acid; 125 deg. F.; 10 days duration.
Test 2: Plant test in 70-74 percent H_3PO_4 containing fluorine compounds, iron, and some sulphuric acid; 241 deg. F.; 120 hr. duration.
Test 3: Laboratory tests in dilute and concentrated phosphoric acid extracted from Florida pebble phosphate; 176 deg. F.; agitated; iron content dilute acid was 0.40 percent Fe, conc. acid 0.73 percent Fe.

	Test 1	Test 2	Tests 3	
			Dilute Acid	Conc. Acid
Monel	X	.49	0.69	1.02
Nickel	X	X	0.80	....
Inconel	0.007	0.67	....	....
Ni-Resist (Type 1)	1.31	....	....	....

x = Specimens completely corroded away; original thickness 0.031 in.

the production of phosphoric acid by phosphorus vaporization processes, Monel is successfully used in contact with the fumes and for fans and other equipment in absorption towers. The results of corrosion tests by Hartford and Copson[5] in the electric furnace process are given in Table IV.

An idea of the highly corrosive nature of the crude phosphoric acid produced by acid extraction processes may be obtained from the test results in Table V.

All of these nickel alloys are highly resistent to the very dilute phosphoric acid solutions used in certain beverage sirups.

References

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2. P. R. Kosting and C. Heins, Jr., *Ind. Eng. Chem.* **23**, 140-150, (1931).
3. Private Communication.
4. C. B. Durgin, J. H. Lum and J. E. Malowan, *Trans.* Am. Inst. Chem. Eng. **33**, 643-668, (1937).
5. C. E. Hartford and R. L. Copson, *Ind. Eng. Chem.*, **31**, 1123-1128 (1939).

LEAD

H. M. CHURCH

Lead Industries Association

New York, N. Y.

LEAD is widely used in the commercial production and handling of phosphoric acid because of its satisfactory resistance to this corrosive. For its corrosion resistance lead usually depends upon the low solubility of the thin adherent film of lead compound formed on its surface. Good protection is offered by the lead phosphate film as it is highly insoluble (0.14 p.p.m., in water). As lead sulphate is also highly insoluble, impure phosphoric acid containing sulphuric acid results in negligible corrosion of lead.

Available data show that lead's resistance to pure phosphoric acid is quite satisfactory and to impure acid is exceptionally good. It is employed with pure acid in concentrations up to 80 percent at 200 deg. C. and with impure acid up to 85 percent concentration. The laboratory data in the accompanying table represent accelerated rates compared with commercial performance but are interesting in showing trends.

Lead-lined wood or steel tanks have proved very satisfactory for the construction of agitators, thickeners, storage tanks, troughs and launders. Where sludges are to be handled, an additional lining of acid-

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Corrosion Rates of Lead in Phosphoric Acid

Acid Conc., Percent	Temp., Deg. C.	Corrosion Rate, Mils per Year
72, pure	20	4.3
65, pure	20	4.3
50, pure	81	65
25, pure	81	43
10, pure	81	1.4
Crude dil.	81	0.0
Crude conc.	80	0.58
Beaker test with pure phosphoric acid:		
85	95	120
25	95	17
25 (aerated)	95	86

resistant brick should be installed to protect the lead from abrasion and from fluorine attack. The majority of failures of lead-lined chemical equipment have occurred as a result of faulty installation or improper design. Where there are temperature changes, sagging of the lead lining is prevented by lead covered steel straps properly spaced, spacing being dependent upon the temperature differential and other local conditions of design and operation. If the temperature change is excessive an acid-resistant brick lining will serve the threefold purpose of giving the lead lining additional support without strapping, preventing abrasive action on the lead, and acting as an insulating layer which permits higher temperatures and more rapid temperature changes.

In some types of agitators and thickeners, the raking blades are of hard lead with grains of aloxite imbedded in the surface for abrasion resistance. This material is called plumbalum and has proved very efficient in resisting combined abrasion and chemical action.

For corrosion resistance, lead pipe and lead-lined steel pipe are used extensively in handling phosphoric acid. The latter is used for operations under pressure and is readily disassembled for ease in removing the crystalline scale which often forms quite readily. The ease of forming extruded lead pipe into coils has brought about the use of lead steam coils in lead-lined evaporators for concentration of the acid.

Homogeneous lead linings may be used in vacuum evaporators and other installations where a vacuum is applied. The evaporator tubes are lead covered copper tubing. Concentration of the acid is also performed in lead vessels employing lead steam coils.

HAVEG

P. L. McWHORTER, Jr.

Haveg Corporation
Newark, Del.

HAVEG is a plastic construction material which is widely used for chemical equipment in corrosive service. Haveg "41," in which the plastic component is of the phenol-formaldehyde type, has been used in phosphoric acid service with good results. In the past, however, there have been limitations both with regard to temperature and concentration. As the result of improvements in the "41" resin the range of successful operation has been greatly extended.

In testing of Haveg material, two strengths of phosphoric acid were employed. Concentrated phosphoric at 1.71 sp. gr. (over 85 percent H_3PO_4) was used in one test, and acid of 50 percent strength

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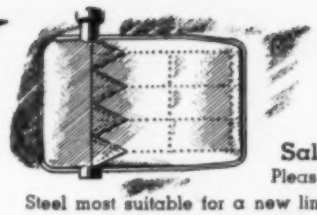
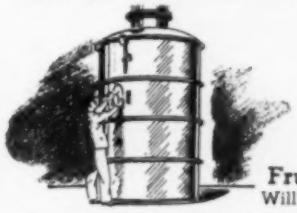
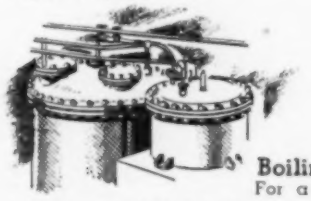


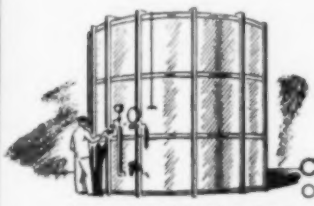
Salt Water?
Please suggest the type of Stainless Steel most suitable for a new line of highest-quality marine trim, including rudders and stabilizer fins.



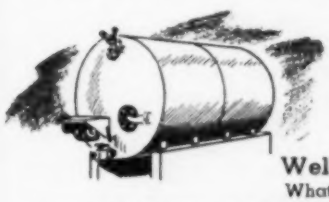
Fruit Juices?
Will E-S 18-8 Stainless (Type 302) canning reservoirs be all right for handling citrous fruit juices including lemon juice?



Boiling Peroxide?
For a new oxidation process using boiling concentrated hydrogen peroxide, would low-carbon E-S 18-8 stainless (Type 304) containers be resistant?



Chloride Storage?
Our processing involves storing cold alkali-metal chloride solutions (aqueous) in E-S 18-8 stainless tanks. How can we inhibit pitting at the liquid line?



Welded Vessels?
What type of Stainless would you recommend for large all-welded autoclaves to handle reactions of maleic anhydride in making synthetic resins?

ES

EASTERN STAINLESS STEEL CORPORATION
BALTIMORE 3, MARYLAND

in another. In the case of the weaker acid, tests were made on submerged samples at temperatures of 25, 50, and 100 deg. C. In the case of the concentrated acid, the tests were conducted at the temperatures stated and in addition at 150 deg. C. The time intervals varied from 80 to 93 days submergence. Samples at the end of the test were evaluated on the basis of weight change, volume change, appearance of sample, and appearance of solution. The individual observations were weighted according to a system which our experience has indicated coordinates well with actual field results.

The earlier Haveg under the conditions stated, rated in the case of the 50-percent acid as excellent at 25 and 50 deg. C., but unsuitable at 100 deg. C. In the case of the concentrated phosphoric, the earlier material rated good at 25 deg. C., fair at 50, but unsuitable at 100 and 150.

For the improved and presently used type Haveg, the results with the 50 percent acid were excellent at 25, 50, and 100 deg. C. In the concentrated acid the newer Haveg was rated excellent at 25, 50, and 100 deg. C. and good at 150.

By relationship of service performance of the older grade with the test performance of the newer grade it would seem that the present type Haveg "41" would offer an excellent material to be employed in many types of equipment where resistance to corrosion by phosphoric acid is a factor.

CARBON, GRAPHITE, KARBATE

L. C. WERKING
National Carbon Co.
Cleveland, Ohio

All of the modifications of carbon used structurally in the chemical industry are inert to ortho-phosphoric acid in all commercial concentrations. These modifications include amorphous carbon, graphite, and "Karbate" impervious carbon and graphite materials. Carbon has been used in electric phos. smelting furnaces, phosphoric acid precipitators and ducts for the past 20 to 30 years. It is also used extensively in hydration towers for the absorption of P_2O_5 burner vapors in water.

In none of these applications is there evidence of attack by phosphorus compounds on the carbon, except a slow solution of electric furnace bottoms in unsaturated ferro-phosphorus. As a matter of fact, phosphoric acid deposits on carbon protect it from oxidation and permit operation considerably above temperatures (350 deg. C.) normally considered possible when excess air is present.

There is a top temperature limitation of 170 deg. C. on Karbate itself, but by proper equipment design it can be operated in P_2O_5 flue gases without damage. Graphite is now successfully used as the burner chamber for producing P_2O_5. Temperatures are held well below oxidizing temperatures in excess air (450 deg. C.) by external water cooling. There is no evidence of reaction between carbon or graphite and phosphoric acid at any known operating temperature in any of these applications.

Karbate products behave similarly from the chemical standpoint, and have been found satisfactory in test and commercial

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installations in concentrations up to 85 per cent H_3PO_4 at atmospheric boiling point. Major applications of Karbate materials are in acid conveying systems (pumps, valves, piping), cooling all concentrations of H_3PO_4 in the manufacture of the acid, and heating solutions typified by those used in the rust-proofing of steel. For cooling, cascade coolers and shell-and-tube heat exchangers are normally used; while for heating, either shell-and-tube heat exchangers or plate heaters are used.

Contamination of the phosphoric acid by fluorides, sulphates, hydrofluoric and sulphuric acids, such as may be encountered in phosphoric acid production by either the wet or electric furnace, has no effect.

HIGH-SILICON IRON

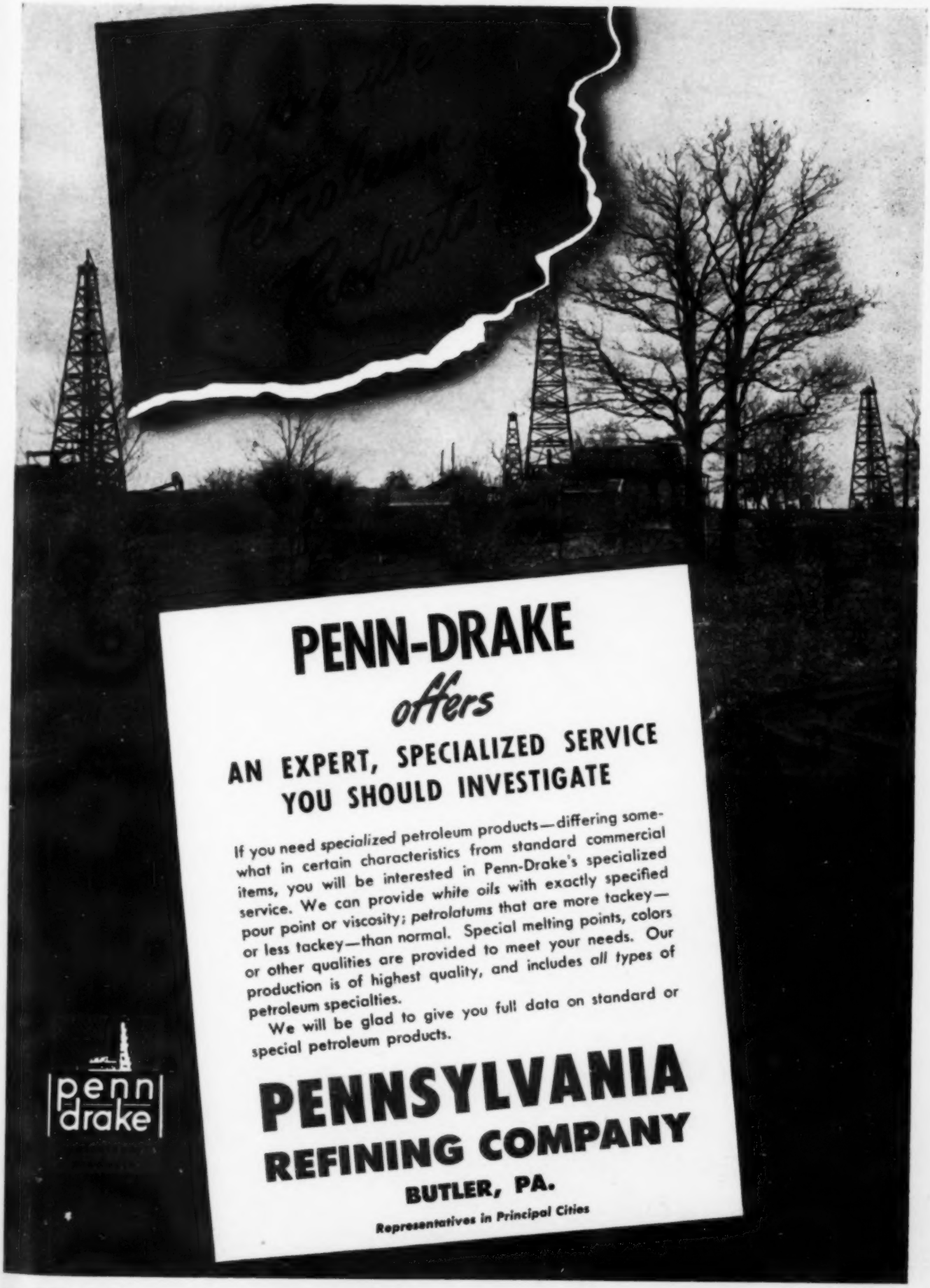
R. M. SHIELDS
The Duriron Co.
Dayton, Ohio

HIGH-SILICON IRON is generally identified as an alloy containing 14.5 percent silicon, 0.6-0.9 manganese and 0.9 carbon. The high silicon content gives the alloy a low tensile strength and a high compression strength, both reflected directly in the type of equipment in which it can be furnished. Design keeps stresses in compression wherever possible. Its low tensile strength, zero elongation, and extreme hardness make the alloy somewhat subject to both heat and physical shock. It is furnished in the cast form only.

It possesses superior resistance to such acids as nitric, sulphuric, phosphoric and others which permit it to establish a silicon oxide film on which its corrosion resistance depends. When the resistant film is established it cannot usually be destroyed by any concentration or temperature of that environment. Phosphoric acid in the pure state permits establishment of this film; consequently high silicon iron can be recommended for phosphoric acid in all concentrations and temperatures.

However, silicon iron cannot be recommended for use on hydrofluoric acid or other compounds of fluorine. Thus the success of using it on phosphoric acid depends entirely on whether the acid is pure or in the crude form, the latter invariably involving compounds of fluorine either as hydrofluoric acid or silicon fluoride. This condition will hold regardless of concentration or temperature of the crude acid.

Much work was done in the 20's on new processes and types of equipment in the manufacture of phosphoric acid, both the so-called dry method using elemental phosphorus and the wet method using phosphate rock. Silicon iron was used widely on both because of its known resistance to phosphoric acid and because its extreme hardness gave excellent resistance to abrasion and erosion in the wet method. Though it was known that the presence of fluorine in the latter might have a marked effect on its life, at least one operator reported that excellent service was derived "even though not recommended by the manufacturer." Much of the original silicon iron remains in service on pure phosphoric acid and in many cases it continues to be used on the crude in spite of its shorter life. Continued use seems justified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Actual tests on Duriron in pure and crude phosphoric acid gave the following data:

Acid Conc., Percent	In. Penetr. per Year
50, pure	0.0072
25, pure	0.0015
10, pure	0.0058
Dilute, crude containing HF	1.40

The above tests were run at 85 deg. C., aerated. Many manufacturers and users of corrosion equipment have accepted 0.03 in. penetration per year as a maximum value to determine whether the use of any alloy should be pursued further for process work. This is particularly true of castings and would not necessarily apply to such forms as sheet or plate. From the above table it is evident that this alloy falls well within the limits excepting on the crude phosphoric containing hydrofluoric acid.

VITREOUS SILICA

WILLIAM W. WINSHIP
The Thermal Syndicate, Ltd.
New York, N. Y.

REACTION between vitreous silica and phosphoric acid is inappreciable at temperatures below 200 deg. C., but increases rather rapidly at higher temperatures. Laboratory tests with acid of 1.75 sp. gr. indicate that it would take about eight months to eat away a thickness of 1 mm. at 217 deg. C. or about 1.4 months at 270 deg. C.

It is readily attacked by fluorine compounds at high temperatures but is unaffected by sulphur trioxide or oxidizing conditions. Mixtures of concentrated sulphuric and phosphoric acids can be distilled in vitreous silica equipment with only very small resultant attack.

Vitreous silica cascade concentration trays, dishes and coolers, similar to those used as sulphuric acid units, have given excellent service in concentrating pure phosphoric acid to U.S.P. strength at operating temperatures of 200-230 deg. C. with an occassional maximum of 260 deg. C. Closed-end tubes of the same material were used in this connection for thermometer and pyrometer wells. The dishes on the lower steps, handling the strongest acid at highest temperatures have rather a short life but the service given exceeds that with glass or porcelain by a considerable margin.

Equipment of vitreous silica is relatively inexpensive compared with other materials offered for handling pure phosporic acid and its solutions and is suitable for the treatment of many other compounds with this reagent. It would appear to be a logical form of equipment for phosphoric acid manufacturing processes involving the use of hydrochloric or hydrobromic acids (e.g., E. Urbain, English Patent 278, 578, Feb. 24, 1927) or nitric acid (e.g., B. A. Bull, U. S. Patent 2, 130, 483, Sept. 20, 1938).

Electric immersion heaters in vitreous silica envelopes are especially adapted to heating phosphoric acid solutions in vessels of any other material, where purity of product is vital.

FROM THE LOG OF EXPERIENCE

DAN GUTLEBEN, Engineer

RUST POLLUTES the food and, if the technologist doesn't know how to avoid the abomination, the advertising mananger makes it palatable. However in sugar and baking powder, the advertiser cannot dispel the prejudice against color. Fortunately, pure sugar solutions do not attack iron, but sirup from which the darkest color grade of brown sugar is made, having a pH slightly below neutral, picks up iron. Iron develops a lustreless gray color. To promote permanence of the golden color, the iron is converted by the addition of phosphoric acid to iron-phosphate, which is assimilable in the human system. The he-man's daily ration requires 10 mg. of iron for strength and 0.88 mg. of phosphorus for his bones. Thus for iron he needs one quarter pound of dark brown sugar daily and for phosphorus, ten pounds.

A STEEL JET CONDENSER, replacing an old one of cast iron, was designed for structural strength only. In a few years during wartime neglect of painting, a sixteenth of an inch of the steel shell was eaten away and 20 percent of the thickness was gone. In nine years the shell collapsed without warning but, since steel can bend and stretch, there was no splash and no casualty. Doubling the plate thickness would have increased the life at least 25 years. On the other hand, the old cast iron condenser with a wall thickness of ¾ in. continued for 20 years, having received an occasional coat of paint. The deterioration did not screech but the decreasing thickness could have been ascertained by test holes. By the warning of an occasional leak through a pit in the metal, a new condenser was ordered and a week after delivery the old one collapsed.

In a similar case in another refinery a few months ago where strike binding had prevented replacement, two mechanics were making temporary repairs by applying red-lead poultices to some small holes. Suddenly the shell collapsed and both men were drawn in by the vacuum and lost their lives. The interior surface can be protected by applying an acid resisting paint once or twice a year but the cost of this over a period of ten years is greater than the amount of metal that is eaten away in the same period.

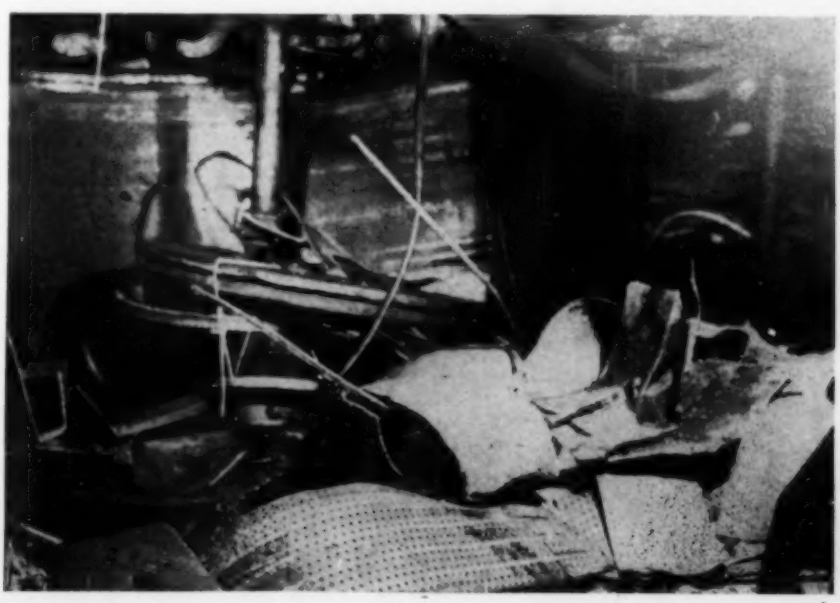
CORROSION AND EROSION in a chemical plant require relentless inspection. A 40-in. centrifugal basket, having served for a period of 25 years, suddenly flew apart at a speed of 1,200 rpm. The photograph shows what happened. If this had occured in any other plant somebody would have been killed, but in a sugar house, providential allowance is made for stupidity—a gift from heaven. This is by no means the first failure of a centrifugal but within the chronicler's 45-yr. experience around the sugar house, no sugar craftsman ever suffered death due to such an accident. Let the picture be a warning lest at some time the guardian angel be temporarily absent doing duty on the highway.

After the explosion the boys dismantled all their centrifugals for a check-up—and none too soon. One of the self-discharge centrifugal baskets is shown in the photograph; note the crack in the bottom cone. The crack was found after the 40-in. basket had been operated for about 90,000 hr., or about two million cycles at 0 to 1,190 rpm. Fatigue supplemented by dezincification is suspected as the cause.

Two men were sucked through the hole when this corrosion-weakened vacuum pan condenser collapsed

RUST RESISTANCE can also be achieved by metal spraying. When the art was young some 20 years ago we purchased the equipment including a sand blasting kit and a book on the theory and

Wreck of a centrifugal (right). After 25 yr. the bronze basket flew apart at 1,200 rpm. General check-up disclosed another basket with ominous corrosion crack (below). Moral: Centrifugals should be inspected annually just as boilers are



practice. We didn't have time to read the book, but Binder, who represented the German licenser and manufacturer, furnished an experienced mechanic. Using block tin, we metalized certain vital parts inside of the fermenter tanks. One of the tanks was tinned over its entire interior area at a cost of $3,000, equal to more than one-third of the subsequent replacement cost of the tank. Where weak spots occurred in the coating, deterioration was accelerated. For the new tanks we later spent $900 for $\frac{1}{8}$ in. extra metal and thus increased life expectancy by 30 yr.

THE OLD MAN OBSERVED with fascination the metalizing of various surfaces. He expressed a desire to cover the inside of an old cast iron vacuum pan with copper. This pan is used for "low" purity sirups containing various organic matters. Big hearted, we proceeded with precipitate eagerness and had the job done in a few days, having spent $1,200. Then came the test. In the first boiling, the iron surface shed the copper in large patches! Post mortem reference to the book disclosed that the quality of the liquid acting as a lye set up a repellent galvanic action between the iron and the copper! The greatest usefulness of the spray torch has proven itself rather in metalizing turbine and pump shafts.

CORROSION and erosion of sugar discharger shafts was eliminated by chrome plating. These shafts, about $2\frac{1}{2}$ in. dia. and $3\frac{1}{2}$ ft. long, slide vertically in a bronze bearing fastened to the cover of the centrifugal curb. At the lower end of the shaft there is a blade 3 to 5 in. wide, which in its downward travel plows the sugar off the screen. Vertical alignment of the shaft must be maintained so as to keep the blade parallel and tangent to the screen. When the blade gets out of line, the corner jabs into the screen and directly requires a $15 replacement. The old steel shafts, through the effect of wear and corrosion from sharp crystals and souring sweet-water, become rough and act like a rasp on the bearings. Accordingly they gradually increase in wobbliness till they have to be discarded. A shaft had a life of six years provided it was occasionally polished and fitted with a new bronze bearing, but the principal costliness of the working condition appeared in the destruction of the screens. The new shafts are now ground, chrome plated to a thickness of 0.008 in., and ground again. The first one thus prepared in 1936 is still in perfect condition.

FOR WHITENESS of product the engineer must restrain rust in steel tanks or else use rustless materials till he develops a less costly substitute. If, in spite of his best knowledge, some harmless impurity remains that he cannot conceal, he can take credit for its presence in glamorous language like the salesman whose House was stuck with a quantity of unpopular light-colored salmon. He added to the label "Genuine Alaska White Salmon. Guaranteed not to turn pink in the can."

PROTECTION AGAINST RUST in sugar-house tanks over the idle season of a few months is obtained by painting the surfaces with sugar sirup. This is effective provided that the condensate from humid atmosphere does not make streaks. Lime whitewash is also an effective temporary protection. These coatings have the advantage of easy removal. Lead paints are not permitted in food products storage tanks because of the prejudice against dissolved lead that may reach the consumer's stomach. For tanks not used for food products where deterioration due to corrosive liquids must be combated, a cheap way to maintain steel plates is to add thickness. This will tide over till the "scientists" evolve something better or the industrialists can reduce the price of stainless steel. An extra eighth of an inch added to the thickness of plates for a fermentor tank or a coal bunker protects the factor of safety for many years.

THE POTENCY OF EXAMPLE of the good painting job in the char house was impressive. A "hewer of wood" had a woodshed to paint and he requested the Chief to secure for him 100 gal. of the same kind of paint that he had seen used in the char house. It was necessary to explain to him that for certain purposes, as for instance, the policy of honesty, the best was none too good. The protection of the char house warranted a paint that cost $3.50 per gal. but for his woodshed something less than the best would serve and so we provided two gallons of barn paint at $1.50.

THE IMPORTANCE of protection of the $35,000,000 Delaware Bridge between Philadelphia and Camden demanded a test at the site rather than a manufacturer's guarantee based on a test a thousand miles away. Long before ground was broken for the foundations samples of a variety of paints, variously applied, were exposed to the ravages that exist right there at the site.

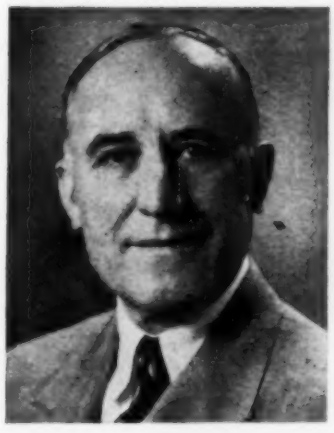
The structural steel in the sugar refinery char house, which is infested with a confusion of gases, was neglected during the first war. The char house is not an attractive place to visit and therefore unexposed to critical inspection, but rust works quietly like a thief in the night. Besides, the war demand for sugar was more vociferous than rust. When relief from the urgency was reached in '23, two sandblasting machines and 28,000 lb. of red lead were purchased, and all of the steel received two coats of red lead and linseed oil followed by one of graphite.

Ten years later, the thoroughness of the job was still justifying its cost, but the importuning salesman—and he has been a welcome kibitzer in our plant—proclaimed that he had a better paint. The engineer accepted a sample without prejudice and added it to the "proving ground" for the benefit of the prospective successor but hesitated to use it in place of the material which by experience had provided perfect protection for at least ten years. However there was curiosity to know why Mojeski had used for the Delaware Bridge the same paint that we did notwithstanding the salesman's superior article. Here the salesman, caught short for an answer, blurted out the wrong one, namely "Mojeski was unwilling to pay the price."

NAMES IN THE NEWS

A. Lloyd Taylor

Allen S. Smith



L. C. Hughes

A. Lloyd Taylor has joined the staff of H. L. Shaw & Sons, Inc., Portsmouth, N. H., as vice president in charge of research and development.

C. Richard Walmer is now medical director of Industrial Hygiene Foundation at Mellon Institute. Dr. Walmer will hold the rank of senior fellow.

Frank H. Lawton is now technical director of Hood Chemical Co., Pittsburgh. He joined Hood after 7 year's association with the Diamond Alkali Co.

Elmer M. Hertzmark is now associated with the Diamond Alkali Co. at their plant in Jersey City.

Herbert W. Henkels has accepted a position as research assistant at the Moore School, University of Pennsylvania.

E. R. Gilmore, who has been chief engineer of Emco Products, has been appointed chief engineer of the Pittsburgh Equitable Meter Division of Rockwell Manufacturing Co.

Robert A. Lees has been named manager of the American Anode, Inc., plant being constructed in Los Angeles and expected to be in operation late this fall.

John R. Brown, Jr., has assumed the duties of director of chemical research of the Prolon Laboratory at the Pro-phy-lac-tic Brush Co.

P. M. Dinkins has been made president and a director of Jefferson Chemical Co., Inc., the company organized two years ago by American Cyanamid Co. and the Texas Co. to produce chemicals from petroleum and petroleum gases.

R. S. Dean, after 17 years with the Bureau of Mines, has left government service to reenter private business.

Allen S. Smith, formerly research director at the Ann Arbor laboratory of the Blaw-Knox Division of the Blaw Knox Co., is now professor of chemical engineering at the University of Notre Dame.

C. Lalor Burdick, of E. I. du Pont de Nemours & Co. has returned from a year of duty in Mexico City. Dr. Burdick now heads a special "high polymer committee" which is studying Du Pont research and maufacturing activities concerned with nylon and similar polymeric compounds. He has been succeeded by **William A. Denker** as chairman of the board of Cia. Mexicana de Explosivos and by **Robert W. Johnson** as chairman of the board of Du Pont S. A.

W. A. Raimond and **T. H. Thelin** have been appointed chief chemists of the vat dyes and intermediates divisions respectively, of Calco Chemical Division, American Cyanamid Co., Bound Brook, N. J. Recently appointed assistant chief chemists were **G. S. Herrick,** basic dyes; **C. E. Lewis,** organic chemicals; and **R. H. Ebel,** rubber chemicals.

Harold G. Turley, head of the leather laboratory of Rohm & Haas Co., Philadelphia, was this year's recipient of the Alsop Award for distinguished contribution to the advancement of leather making. The award, instituted in 1939 by the Tannin Corp., was made at the recent annual convention of the American Leather Chemists Association.

Henry H. Thomas has joined the research and development staff of the Pemco Corp., Baltimore.

Felix C. Rodgers has been appointed general manager of the fire division of the Cardox Corp. of Chicago. **H. V. Williamson,** formerly chief engineer of the company's research division, is now director of research.

Leslie C. Hughes, consulting chemical engineer, has been appointed consulting engineer for the chemical and process industries by the H. K. Ferguson Co.

Willis M. Cooper has been transferred from the St. Louis office of Monsanto Chemical Co. to the London office of Monsanto Chemicals Ltd., where he will act as assistant and project engineering advisor to the engineering director.

Roger Adams, head of the department of chemistry in the University of Illinois and one of the nation's leading organic chemists, has been awarded the Priestley Medal of the American Chemical Society. Dr. Adams, chairman of the Society's board of directors, received the medal on September 11 in Chicago.

W. M. Shafer, until recently a member of the research and metallurgical staffs of Fansteel Metallurgical Corp., North Chicago Ill. is now with the research department of the National Radiator Co.

Dave Wetherly, chemical engineer who participated in a supervisory capacity during the design and construction program at the Oak Ridge, Tenn., atom bomb plant, has been named contract engineer for the eastern district by the H. K. Ferguson Co.

W. E. Jones, who has been associated with Diamond Alkali Co. for 30 years, resigned September 1.

R. C. Jones has been appointed general manager of the rayon division of Celanese Corp. of America to fill the post vacated by **John E. Bassill,** who retired from the company on September 1.

E. E. Lindsey and **Frank S. Riordan** have joined the staff of the department of chemical engineering of the University of Tennessee. Dr. Lindsey was with the

Houdry Process Corp. and Yale University before his recent duty with the Navy. Mr. Riordan has been a chemical engineer with the Bureau of Mines at the Electrochemical Laboratory in Norris, Tenn.

Ward V. Evans will receive the 1946 Honorary Scroll Award of the American Institute of Chemists at a dinner meeting of the Chicago Chapter on October 4. Professor Evans is being honored for outstanding achievements as a teacher and as an industrial consultant.

Charles W. Palmer, a vice president of Canadian Celanese, Ltd., since 1930, and a member of the board of directors since 1938, has been elected executive vice president, and a member of the finance and executive committee. **William McC. Cameron** has resigned as vice president of the company, but will continue as a director and member of the finance and executive committee.

John M. Cannon is now chief engineer of the chemical engineering division of S. D. Hicks & Son Co., Boston.

R. W. Trullinger has been appointed chief of the Office of Experiment Stations, U. S. Department of Agriculture, to succeed **James T. Jardine** who retired July 31.

Al C. Funk has retired from active business life after 35 years with the National Adhesive Division of National Starch Products, Inc., and its predecessor companies.

William L. McCracken, recently discharged from the U. S. Army Engineers with the rank of lieutenant colonel, has been appointed administrative assistant to the vice president in charge of research and engineering of Detrex Corp., Detroit.

F. M. Rogers, chief chemist at the Whiting laboratories of Standard Oil Co. (Ind.), retired September 1 after 38 years with Standard Oil. He has been succeeded by **P. C. White.**

A. Douglas McLaren has been appointed an assistant professor assigned to the Institute of Polymer Research of the Polytechnic Institute of Brooklyn, where he will be active both in research and teaching. He was formerly with the Du Pont Co.

Herbert E. Schweyer has resigned from the Texas Co. and is now associate professor of chemical engineering at the University of Florida.

Joseph H. Koffolt, of the chemical engineering department of the Ohio State University, has been elected chairman of the American Chemical Society's Columbus Section succeeding **John S. Crout** of the Battelle Memorial Institute.

Hugo Klein, who recently resigned as vice president in charge of chemical production and research of the Charles Bruning Co. Inc., New York, has accepted the posi-

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Type GUAP Explosion-Proof Conduluet


Type EFSC Two-Gang Explosion-Proof Push Button Switch Conduluet


Type CPS "T" Explosion-Proof Conduluet


Type GUJL Explosion-Proof Conduluet


Type OFC Explosion-Proo. Push Button Station Conduluet


Type GUEL Explosion-Proof Conduluet


Type EGP Explosion-Proof Push Button Station and Pilot Light Conduluet for panel mounting


Type EJH Explosion-Proof Conduluet with Dome Cover


Type EBC Explosion-Proof Conduluet


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Type EHS Explosion-Proof Signal Light Conduluet


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Type EVH Explosion-Proof Hand Lamp


Type EVA Explosion-Proof Lighting Fixture 150 Watt


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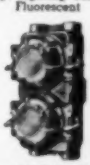
Type ELG Explosion-Proof Gauge Lighting Conduluet


Type EVA Explosion-Proof Lighting Fixture 500 Watt


Type EMS Explosion-Proof Mercury Limit Switch Conduluet


Type BCDE-8 Explosion-Proof Floodlight 200 Watt


Type ELG Explosion-Proof Gauge Lighting Conduluet Fluorescent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Type EDP Explosion-Proof Panelboard

Type FLDC Explosion-Proof Secondary Breaker Conduluet

Type FGCH Explosion-Proof Switch Conduluet for gasoline bulk stations

Type EYS Explosion-Proof Sealing Conduluet

Type GUAC Explosion-Proof Conduluet

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tion of manufacturing manager of Converted Rice, Houston, Tex.

Granville M. Read is now chief engineer of E. I. du Pont de Nemours & Co. He was promoted from his position of assistant chief engineer to succeed **Everett G. Ackart**, who retired September 1 after nearly 40 years with Du Pont.

Thomas W. Nale, M. D., formerly plant physician of the South Charleston works of Carbide and Carbon Chemicals Corp., has been appointed assistant manager of the industrial toxicology department of Union Carbide and Carbon Corp., New York.

Harry A. Kuhn has retired because of disabilities in line of duty from his post of chief of the control division, Chemical Corps. Colonel Kuhn will remain in Washington, D. C. where he will open a consulting office.

Howard P. Milleville, research chemical engineer, has resigned his position at the Eastern Regional Research Laboratory of the U. S. Department of Agriculture at Philadelphia, to enter the new laboratories of Donald K. Tressler and Associates at Westport, Conn.

Charles C. Price, III, head of the chemistry department in the University of Notre Dame, has been awarded the $1,000 American Chemical Society Prize in Pure Chemistry for 1946. The award, made annually, was presented to Professor Price in Chicago on September 11.

Martin T. Bennett has opened an office at 917 15th St., N. W., Washington, D. C., for the practice of general industrial engineering. Mr. Bennett is a chemical engineer with long experience in public utility work.

Edward C. Sterling has been elected chairman of the American Chemical Society's Western Connecticut Section succeeding **R. C. Swain.**

Bernard H. Gilmore, formerly with the research laboratories of H. J. Heinz Co., has joined the research and development staff of Calgon, Inc., Pittsburgh, Pa., as food technologist.

John W. Beaty, formerly associated with the E. I. du Pont de Nemours Co., has joined the technical staff of the Quaker Oats Co. as chief chemist for the feed mill located at Memphis, Tenn.

Walter Dannenbaum has been appointed general manager of the ammonia department of E. I. du Pont de Nemours & Co. He succeeded **F. A. Wardenburg,** who has retired after 39 years with the company.

Leonard T. Beale, president of the Pennsylvania Salt Manufacturing Co. and **Richard L. Davies,** assistant to the president of Pennsalt have received from King Christian X the King Christian X Medal of Liberation for their efforts for the Danish cause during the years of Nazi occupation. Their activity came about as a result of the long association of Pennsalt with the

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Danish government and Danish companies dating from 1865 when Pennsalt entered into its first agreement to import crude cryolite ore from the mines near Ivigtut, Greenland.

A. D. Andriola has been appointed chief research engineer to head a recently announced engineering research program of the De Laval Steam Turbine Co. of Trenton, N. J.

William P. Campbell, leader of the paper makers chemical research group at the experiment station of Hercules Powder Co. near Wilmington has been appointed director of development of the PMC department with headquarters in the Wilmington home office. **W. Donald Thompson, Jr.,** formerly assistant group leader is now acting group leader. Research chemists **James W. Davis** and **Stearns Putnam** have been named assistant group leaders.

Harold C. Weingartner, a chemical engineering graduate of the University of Illinois, has been appointed chief engineer of the vacuum engineering division of the National Research Corp. of Boston.

Charles W. Hymer, manager of the sporting powder division of Hercules Powder Co.'s Explosives Department since 1919 retired September 1. **Henry N. Marsh,** manager of smokeless powder operations, will take over management of the sporting powder division as well, with the title of manager, smokeless powder division.

Robert J. Davis, a chemical engineering graduate of the Massachusetts Institute of Technology has joined the technical service department of Colgate-Palmolive-Peet Co., Jersey City, N. J.

Frederick C. Abbott, formerly manager of the new products division, has been named assistant to the production manager in the manufacturing department of the Pennsylvania Salt Manufacturing Co. **Hugh R. Bishop,** recently released as a lieutenant colonel in the air forces after four years of service, has been named manager of the new products division replacing Mr. Abbott. **Martin E. Johnson** has been transferred from the market research department to the new products division.

C. T. Carson has been elected vice president of Hiram Walker & Sons, Ltd. He will be in charge of production at the company's distillery in Walkerville, Ontario.

Warren W. Burr, paint, varnish and lacquer expert who served as a naval officer in World War II, now heads the section on development of protective coatings and Pliolite resins of the research staff of The Goodyear Rubber & Tire Co.

Eugene C. Crittenden, associate director of the National Bureau of Standards has been elected to membership in the International Committee on Weights and Measures.

R. L. Baldwin has retired. He was sales

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development manager, Electrode Products, National Carbon Co. Inc.

Hayden B. Kline, director of Industrial Rayon Corp., has been elected to the newly created post of executive vice president and to membership on the executive committee.

Rufus E. Zimmerman, vice president in charge of research and technology of the United States Steel Corp. of Delaware, has been elected to receive the medal for the advancement of research awarded annually by the American Society for Metals. It will be presented in Atlantic City, November 21.

John R. Lacher, formerly with the Du Pont Co., has taken the position of assistant professor of chemistry at the University of Colorado. Other additions to the University of Colorado faculty include **Karl Dittmer,** assistant professor of chemistry, from Cornell University; **Stanley Cristol,** assistant professor of organic chemistry, from the Department of Agriculture; **John S. Meek,** instructor, from the University of Illinois; and **Orville J. Sweeting,** assistant professor of chemistry, from Cornell.

J. D. Fennebresque has been appointed general manager of the chemical division of the Celanese Corp. of America.

Hugo Hiemke has joined the Pacific Coast division of the A. O. Smith Corp. as assistant director of the company's service and development laboratory in Los Angeles. He will work on technical problems arising in the company's west coast plant and in the plants of two subsidiary concerns, the Sawyer Electrical Mfg. Co. and the Smith Meter Co.

OBITUARIES

Logan G. Thomson, 61, president of the Champion Paper and Fibre Co., Hamilton, Ohio, died in La Jolla, Calif., last month.

Wilmer E. Crawford, 66, head of the Wilmer H. Crawford Chemical Co. and a former president of the Cincinnati Paint, Oil and Varnish Club, died in Avondale, Ohio, August 5.

Carl L. Breithaupt, 50, consulting engineer for the Prior Chemical Co. of New York, died while vacationing in Canada, August 13.

J. W. Wizeman, chief of the inorganics branch of the chemicals division, Civilian Production Administration died at his home in Arlington, Va., August 15.

Gerald Thorp, vice president of the Bethlehem Foundry and Machine Co., Bethlehem, Pa., died August 22.

Harvey P. Thelen, 36, product sales manager, steel containers, Continential Can Co,. died in New York August 24.

Karl F. Stahl, 91, internationally known chemist, died in Pittsburgh August 27.

INDUSTRIAL NOTES

Blaw-Knox Construction Co., Chemical Plants Division, Pittsburgh, has a contract from Colgate-Palmolive-Peet Co. for design and processing equipment to be located at Kansas City, Kans.; Jeffersonville, Ind.; and Jersey City, N. J.

Gas Atmospheres, Inc., Cleveland, has been formed to design, manufacture, and sell various types of equipment and processes to produce industrial gas atmospheres. A. A. Straub is president and general manager and headquarters are at 20011 West Lake Road.

Allis-Chalmers Mfg. Co., Milwaukee, has named Irwin McNiece assistant district superintendent of service and erection for the Los Angeles district.

Chain Belt Co., Milwaukee, has purchased the heavy ordnance plant constructed for the Defense Plant Corp. at West Milwaukee.

Combustion Engineering Co., Inc., New York, has formed Combustion Engineering de Mexico S. A., located at Lopez, Mexico, D. F. Resident executives of the new company are George C. Siefert, vice president and general manager and Seldon Merrill, manager of installation and service.

Rockwell Mfg. Co., Pittsburgh, has established a new hydraulics division to specialize in the development of hydraulic equipment. W. H. Marsh is general manager of the division.

Brown Instrument Co., Philadelphia, has appointed I. K. Farley petroleum industry sales manager. R. A. Schlegel has been transferred from Chicago to New York where he will have charge of petroleum accounts in that area.

Westinghouse Electric Corp., Pittsburgh, has selected R. F. Wright as manager of its office in Chattanooga, Tenn., to succeed J. G. Simpson who has retired.

American Cyanamid Co., Calco Chemical Division, Bound Brook, N. J., has appointed W. M. Boyce as southern representative for the Heller & Merz department.

Valve & Primer Corp., Chicago, is now represented in New York by A. H. E. Berchem of the Berchem Co., with offices at 50 Church St.

Ampco Metal, Inc., Milwaukee, has transferred Henry A. Mullen from Detroit to the main office where he will serve as manager of resistance welding sales.

Elliott Co., Jeanette, Pa., has placed E. I. Pollard in charge of electrical engineering replacing Quintin Graham who recently

Enduro Pays in many ways

Republic ENDURO Stainless Steel—the metal which possesses exceptional resistance to intense heat and severe corrosion—is the ideal material for many different types of high temperature equipment.

ENDURO possesses high creep strength—and resists scaling in high temperature applications—thereby effecting substantial savings in both equipment maintenance and replacement costs.

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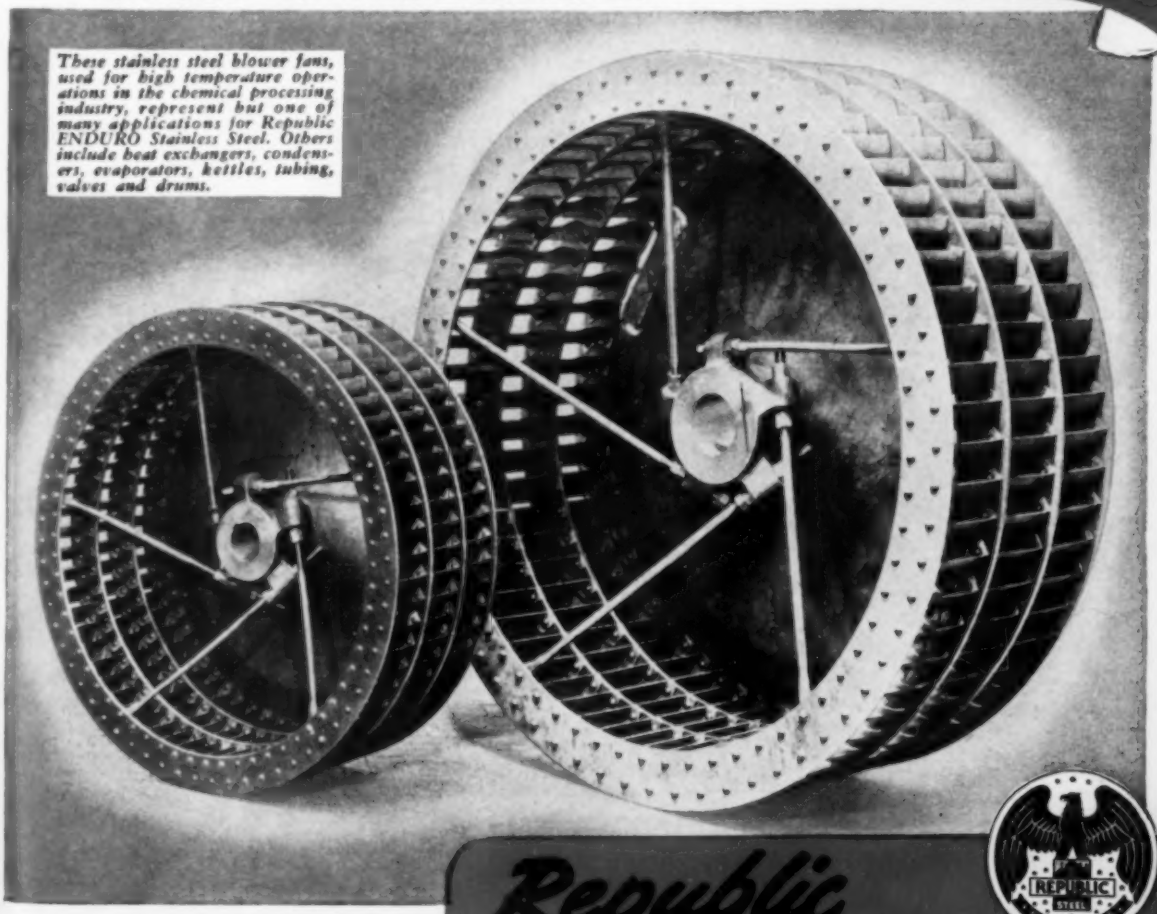

These stainless steel blower fans, used for high temperature operations in the chemical processing industry, represent but one of many applications for Republic ENDURO Stainless Steel. Others include heat exchangers, condensers, evaporators, kettles, tubing, valves and drums.

Republic ENDURO STAINLESS STEEL
Reg. U. S. Pat. Off.

Other Republic Products include Carbon and Alloy Steels—Pipe, Sheets, Strip, Plates, Bars, Wire, Pig Iron, Poles and Steel Tubing

was appointed assistant manager of the Ridgway Division.

Freeport Sulphur Co., New York, has elected Frank Hamilton vice president of its subsidiary, Nicaro Nickel Co. Mr. Hamilton has been serving as assistant to the president.

Patch and Talmage, Stamford, Conn., is a new partnership firm organized by Earl S. Patch and C. Robert Talmage to serve industrial companies in the field of powder metallurgy.

Independent Pneumatic Tool Co., Chicago, has opened a branch office in St. Paul, Minn. It is in charge of Joseph A. Bell who for the last six years has represented the company in that area.

Timken Roller Bearing Co., Canton, Ohio, announces that R. E. Wagenhals, formerly quality control engineer, is now director of quality control for all bearing divisions of the company.

Hardinge Co., Inc., York, Pa., is represented in the Gulf Coast territory by C. L. Chavigny Co., Sterling Bldg., Houston, Tex. This company also represents the American Hard Rubber Co., R. P. Adams Co., Goslin-Birmingham Mfg. Co., Hasco Valve and Machine Co., and American Heat Reclaiming Co.

Merchants Chemical Co., Elm Court, Stamford, Conn., has been formed to manufacture industrial coatings and finishes. Victor F. Mutch, formerly president of Cordo Chemical Corp., is president of the new company.

Lukens Steel Co., Coatesville, Pa., has opened an office at 332 South Michigan Ave., Chicago, with John H. Faunce, Jr., acting as manager of sales.

St. Regis Paper Co., New York, has opened a branch office for its subsidiary, St. Regis Sales Corp., in the Farr Bldg., Allentown, Pa. J. Lea Fearing, Jr., is in charge of the office and will handle sales of the multiwall paper bag division.

Lion Oil Co., El Dorado, Ark., has appointed Norman H. Eason as assistant sales manager of its chemical division. Mr. Eason will handle the sale of ammonium nitrate fertilizers.

E. I. du Pont de Nemours & Co., Wilmington, has transferred Dr. Emil D. Ries from the position of assistant director of sales of the ammonia department to assistant general manager of the department. Walter Dannenbaum has been general manager of the department since June 30.

Koppers Co., Inc., Pittsburgh, has consolidated all public and advertising activities of the company into a new unit to be known as the Public Relations Section. Robert H. McClintic has been appointed director of public relations.

Westvaco Chlorine Products Corp., New York, has opened an office at 1900 East Jefferson St., Detroit, with Donald C. Oskin in charge. Mr. Oskin joined the

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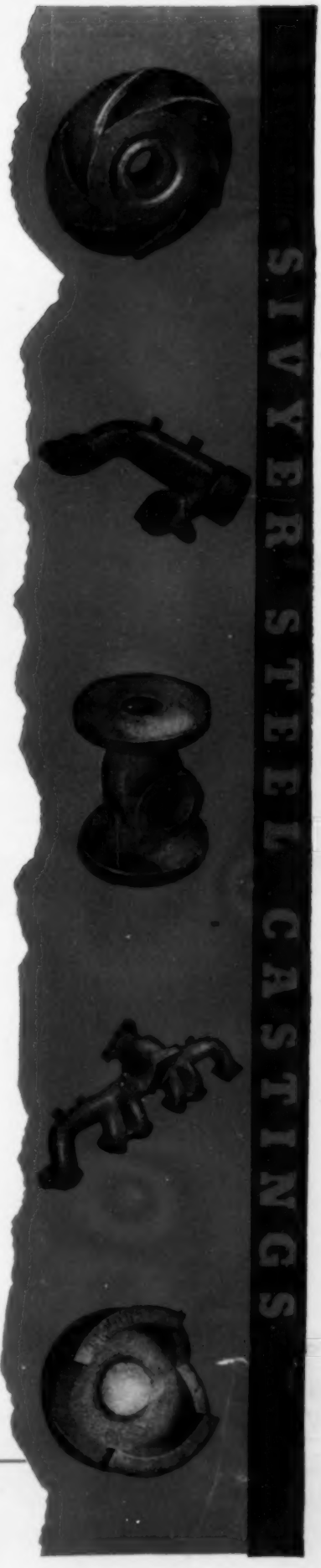


company late last year after serving for four years in the armed forces as a major on the staff of General Doolittle.

Monsanto Chemical Co., St. Louis, has appointed F. Faxon Ogden manager of special products sales development for the Merrimac Division in Boston and J. J. McCarthy manager of chemical sales development in charge of new products for the paper and leather industries.

Taco Engineering Co., 2620 South Park Ave., Chicago, has been formed by Theodore A. Cohen. The company is a consulting, designing and manufacturing organization specializing in electronic and electro-mechanical automatic control equipment.

American Car and Foundry Co., New York, has appointed R. S. Slater manager of tank car sales in charge of sales of tank cars, storage tanks, and pressure vessels.

National Tube Co., United States Steel Corp. subsidiary, Chicago, has elected William F. McConnor to the position of vice president in charge of sales.

Moore Products Co., Philadelphia, has opened an office in 105 West Monroe Bldg., Chicago, with Jack J. Fregean in charge of sales and service.

John A. Roebling's Sons Co., Trenton, N. J., has promoted Forest S. Burtch to manager of sales, wire rope division, and William Hobbs, Jr., to manager of sales, aircord division.

Standard Engineering Co., Youngstown, Ohio, has advanced William Rodder from the position of chief engineer to director of engineering. Perry Snyder succeeds him as chief engineer.

Farrel-Birmingham Co., Inc., Ansonia, Conn., has moved Harry D. Temporal from Akron to Chicago where he will manage the company's office. He is succeeded at Akron by William R. Bowen who has returned to the company after serving as lieutenant-commander in the Navy.

American Cyanamid Co., Calco Chemical Division, Bound Brook, N. J., announces that the new office of the Chicago branch of its pigment department is located at 228 North LaSalle St. This is headquarters for Gerald J. Boyer, Kenneth A. Coate, and Paul J. Cucnot.

Hydropress, Inc., New York, has opened a branch office in the Industrial Bank Bldg., Detroit which is under the supervision of Roland S. Higgins who has been serving in the Office of the Chief of Ordnance—Detroit, with the rank of major.

Clark Bros. Co., Inc., Olean, N. Y., has added three new members to its staff. T. R. Foster will head the centrifugal compressor sales department at Olean; Joe Y. Allen, Jr., will act as engineer in the technical service department at Houston, Texas; and G. R. Maddox will go to Venezuela where he will open a branch office in Caracas.

CONVENTION PAPER ABSTRACTS

CONTENTS

THE MAGNESIUM CONTENT OF FERTILIZERS

SEVENTY percent of the magnesium added to crops in recent years has been in the form of liming materials. Ten years ago 80 percent was in the form of animal manure. This rapid change has been due to the tremendous increase in the use of ground limestone and to an increase in the average magnesium content of the limestone used. Relatively less dolomite is now used to make mixed fertilizers than in 1937 although the total tonnage is larger. The percentage of water-soluble magnesium in mixed fertilizers has increased. Nearly all of the common fertilizer materials contain small proportions of magnesium. Thus mixed fertilizers always contain traces even though none is intentionally added. The magnesia content of 62 representative samples of mixed fertilizers manufactured without any of the recognized magnesium carriers, such as dolomite, Cal-Nitro, sulphate of potash-magnesia, etc., is 0.28 percent.

A. L. Mehring, Bureau of Plant Industry, Soils, and Agriculture, before Division of Fertilizer Chemistry, American Chemical Society, Chicago, Sept. 10, 1946.

TOXICITY DATA FILES OF THE CWS

THE ESTABLISHMENT of the Toxicity Files Section of the Information Division in 1941 initiated a new informational service designed to make readily available to Chemical Warfare Service technical personnel all data (chemical, physical, toxicologic, protection, field-test, etc.) on the now approximately 5,000 compounds that have been studied as possible chemical warfare agents, thus eliminating the necessity of time-consuming library searches through our many thousands of unpublished technical reports. References, data, abstracts, and critical evaluations made in this section are all readily available through the Toxicity Files Index and "Toxicity Folders." An important feature of the work is the critical evaluation of techniques used,

data reported, and conclusions drawn. An authoritative "Toxicity Data Sheet" is prepared for each compound. Very recently work has been started on a series of monographs presenting the available data on the different types of compounds studied, and correlating, as far as possible, the physiologic effects with chemical structure and chemical and physical properties. An important aspect of the work of this group it its association with the Insect Control Committee of the National Research Council in the development of a system of classifying and coding chemical compounds so that the use of punched cards and a sorting machine will make it possible to locate easily and surely all related compounds on which data are available. Such cards will be made for our files as soon as the system of coding is ready for use.

E. L. Wardell, Information Division, before Division of Chemical Engineering, American Chemical Society, Chicago, Sept. 11, 1946.

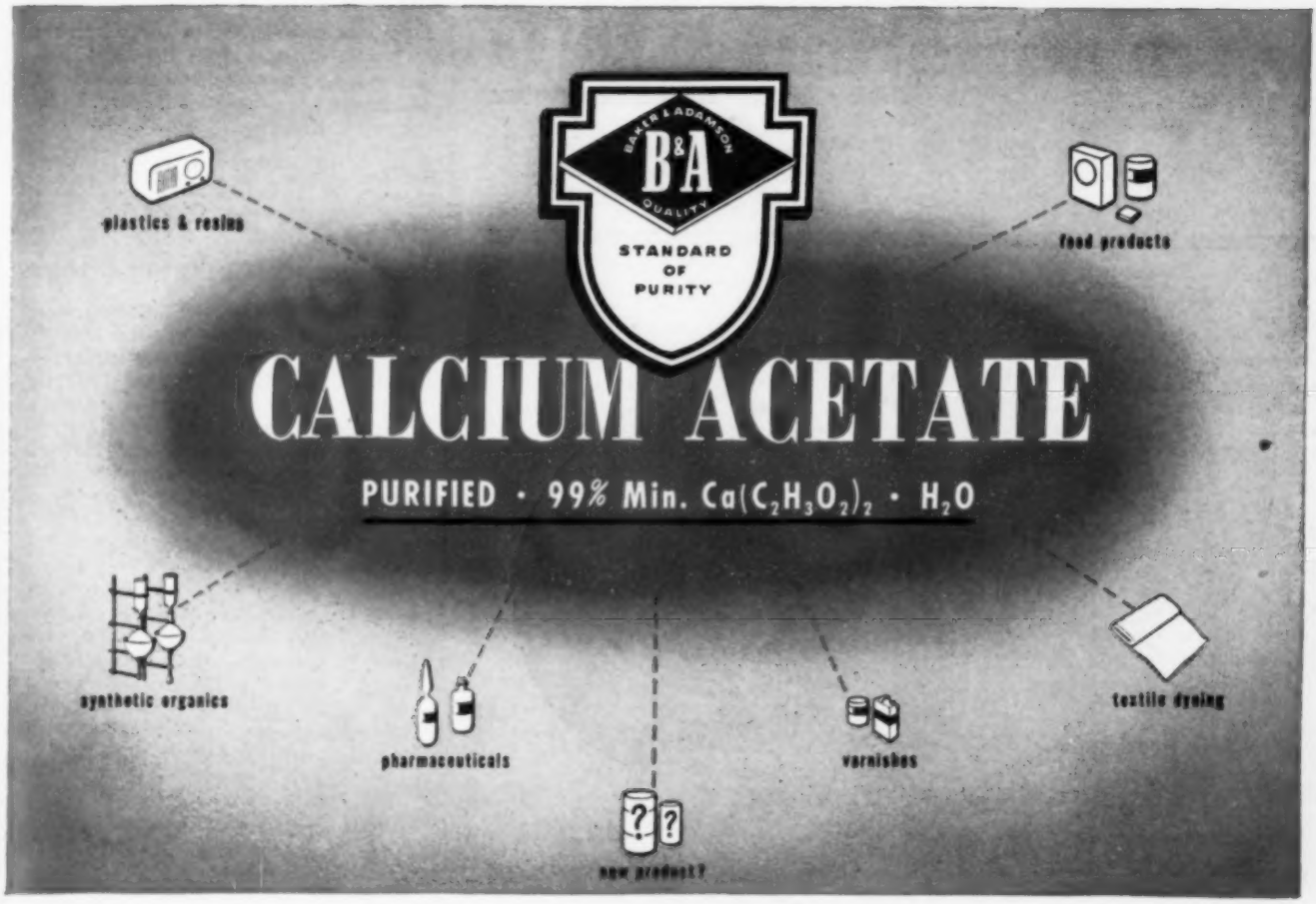
THE MANUFACTURE OF PIGMENT-IN-OIL PASTES

"Flushing" is the process of transferring to an oily vehicle of pigment particles from the wet filter cakes resulting at the end of the chemical manufacture. It is accomplished in powerful kneaders with the aid of a surface-active agent, and has been the most satisfactory process for making pigment-in-oil pastes from wet pigment toners and lakes, since it obviates the necessity of converting the latter to a fine pigment powder and subsequent grinding into the oily vehicle on milling rolls.

A more economical process has been developed which somewhat resembles the newer type of emulsion-flushing procedures, eliminates the need of surface-active agents and powerful kneaders by absorbing the oily vehicle on the pigment particles while they are still slurrying in their striking solution. The resulting pigment-in-oil slurry acts like the slurry of the oil-free pigment; it filters as fast, it can be washed to remove all acid and other impurities, and it can be dried under vacuum. In its dried form, it is still a solid; however, it becomes a paste when subjected to pressures; or it can be converted readily into oil paints with paint thinners which are solvents for the vehicle.

The new process is applicable to manufacture of many different pigments, but it was especially developed for the poly-acid toners of rhodamine B, which require fairly strong acid solutions and the absence of the usual surface-active agents to avoid "bleeding of the color," a term denoting the partial redispersion of the pigment in the water layer and indicating a proportionate loss in yield. In order to effect substantially complete oil adsorption, the pigment was in a state of very fine subdivision, such as is obtainable in emulsions made with dilute ammonia solutions. These emulsions readily break when they are made acid. Their breakdown starts immediately as they enter the acid pigment slurry. However, the adsorption by the pigment proceeds sufficiently fast, so that under proper conditions a negligible amount of oil fails to be adsorbed.

Prior to the addition of the emulsion,



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Many are the established applications of this B&A Fine Chemical. Perhaps it has a place in your process too. If so, let us know your requirements now. And remember—whether you need purified Calcium Acetate in bottle, drum, or even carload lots—Baker & Adamson can supply it promptly and steadily. That's important when your production schedules press.

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SETTING THE PACE IN CHEMICAL PURITY SINCE 1882

* Complete stocks carried here.

there may be adsorbed on the pigment a colloidally dispersed phenolic resin. This decreases the loss of oil and promotes the more rapid and complete oil adsorption by the pigment.

A. F. Schmutzler and D. F. Othmer, Polytechnic Institute of Brooklyn, before Division of Industrial and Engineering Chemistry, American Chemical Society, Chicago, Sept. 9, 1946.

LABORATORY LOCATION FACTORS

SELECTION of a proper laboratory location must be keyed in with the research objectives to be pursued. Pioneering research usually thrives best in a setting isolated from practical pressures of plant or sales organization. At the other extreme in type of research—service work on established products and applications—proximity of the laboratory to the plant or sales service unit is a prime necessity. In a large company, both purposes are served by dividing research among several locations—process service laboratories set up at key plants, technical sales laboratories located where they can best serve major sales outlets, scouting and fundamental research and new development work concentrated at a central laboratory. Geographical separation in this case should be compensated by liberal interchange of personnel and thorough liaison.

With smaller companies, one laboratory location may serve all purposes, but division of research objectives should be accomplished through grouping of staff and facilities. In this case, lack of geographical isolation of exploratory research can be compensated by separation of laboratory administration from direct control by production or sales organization.

R. W. Cairns, Hercules Powder Co., before Division of Industrial and Engineering Chemistry, American Chemical Society, Chicago, Sept. 10, 1946.

MINING AND PROCESSING LANGBEINITE

THE ONLY deposits of langbeinite known to exist in the United States are being mined by International Minerals and Chemicals Corp. at Carlsbad, N. M. The mining of these ores was started in October 1940 and production has steadily increased from 28,672 tons in the 1941-42 fiscal year to 85,701 tons in the 1945-46 fiscal year just closed. Production of washed langbeinite, or "Sul-Po-Mag," is expected to reach 100,000 tons in the 1946-47 period.

The geology of the region is complex and is not fully revealed. A thick series of evaporates was laid down in the deeper part of an old Permian sea which had been almost surrounded by a limestone reef. Beds of langbeinite occur at two horizons in this series and through small rivulets. In places sylvite is mixed with langbeinite or may surround or overlie bodies of langbeinite ore. Intensive study of the deposits is under way.

Mining is by room-and-pillar method and operations are carried on with the latest in mechanical equipment. There are no tracks on the level and haulage is by means of rubber-tired shuttle cars operated from a double overhead trolley system and cable reels. The ore is undercut, and

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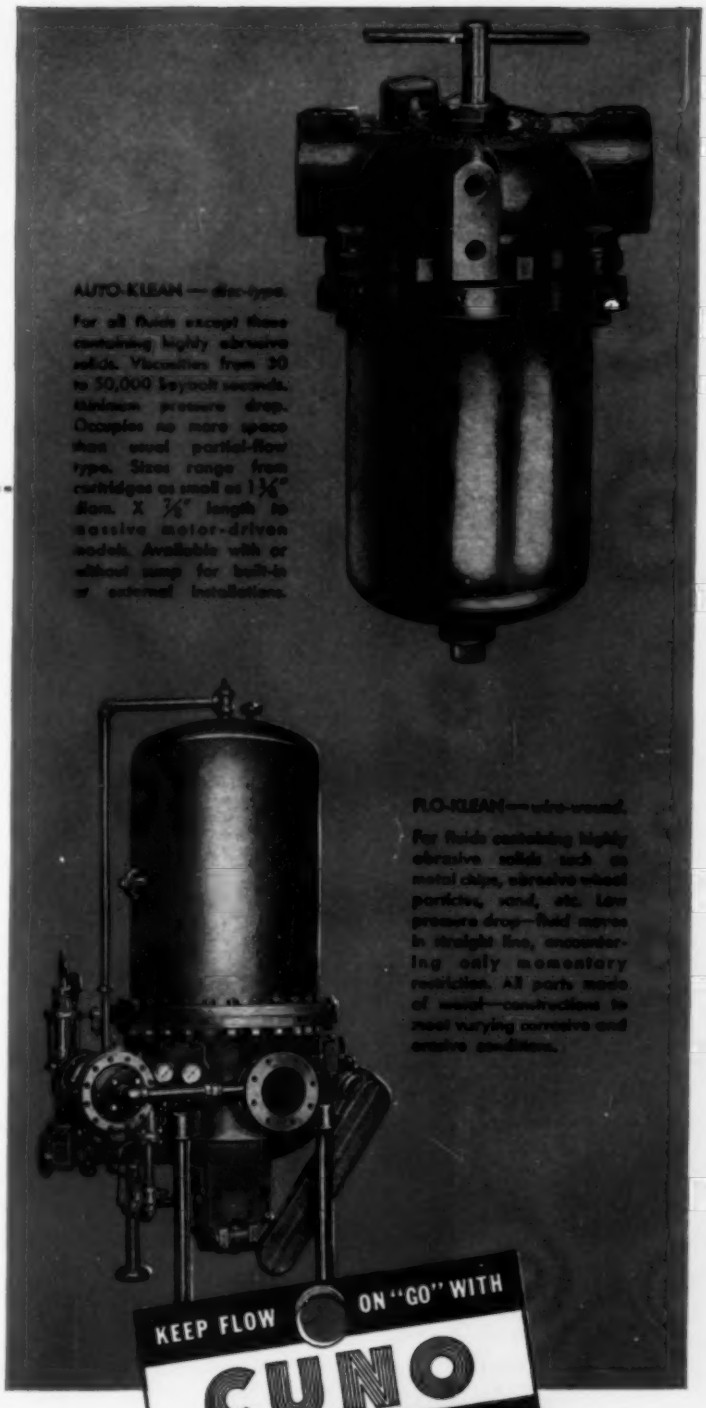
There is nothing, in either model, to remove or renew. The filter element is all-metal, non-collapsible. The only attention required is periodic emptying of the sump.

For positive cleaning action that is effective, as specified, down to .0025" particle size, specify Cuno. See Cuno catalog in SWEET'S for selection factors and specifications; or send coupon for complete Cuno catalog. Staff engineers are available for special recommendations.



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- ☐ Fuel Oil
- ☐ Fuel Tar
- ☐ Gases
- ☐ Gasoline
- ☐ Grease
- ☐ Grinder Coolant
- ☐ Hydraulic Oil
- ☐ Japan
- ☐ Lacquer
- ☐ Lubricating Oil
- ☐ Machine Tool Cutting Oil
- ☐ Machine Tool Hydraulic Oil
- ☐ Machine Tool Lubricating Oil
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- ☐ Oils
- ☐ Paint
- ☐ Pyroxylin
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- ☐ Resins
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- ☐ Solvents
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drilled with electric augers, similar to coal mining practice. The level is equipped with modern electrical and mechanical shops which permit almost a complete repair and maintenance schedule.

The preparation of the finished langbeinite, or "Sul-Po-Mag," is by simple crushing and washing in fresh water to dissolve the halite and wash out the clay impurities. The solid langbeinite is then centrifuged and dried and placed in a storage warehouse, ready for market. By hydrating langbeinite and combining it with sylvite in a base-exchange process, magnesium is eliminated with the substitution of potassium to make sulphate of potash, containing 90 to 95 percent potassium sulphate.

G. T. Harley, before Division of Fertilizer Chemistry, American Chemical Society, Chicago, Sept. 10, 1946.

PHARMACEUTICAL SHORTAGES

THERE has been hardly any shortage of drugs throughout the war, and there are only a few shortages now. Competition has been severe in competitive lines, and was severe on bids for Army and Navy requirements. The price war on penicillin became so extreme, that some manufacturers were selling below cost. There is no possibility of general price increases, owing to competition. Some of the botanicals are somewhat short, and have increased in price, but the over-all picture is decidedly favorable from the consumer standpoint. In 1939 the total production of drugs, pharmaceuticals and medicinals amounted to $492,700,000. In 1944 this had risen to $1,025,000,000, which is more than double. Total production in 1945 was higher than that of 1944.

G. F. Rorer, William H. Rorer, Inc., before American Pharmaceutical Manufacturers' Association, Lake Louise, Canada, June 10, 1946.

THE USE OF TANNINS IN MERCAPTAN REMOVAL

MERCAPTANS can be removed from the gasoline in several ways, for instance, by converting them to disulphides, by removing all sulphur-containing compounds through treatment with sulphuric acid or clay, or by scrubbing the gasoline with a caustic soda solution. The latter type of treatment not only removes the odor but produces a better motor fuel with a higher octane number.

If the gasoline is scrubbed with a caustic soda solution, this solution must be regenerated before the solution can be reused. Regeneration of the caustic soda solution can be accomplished by blowing air through the solution, thus converting the mercaptans to disulphides which settle out and are removed. To speed up this conversion, catalysts are added. The catalysts must be soluble in the caustic soda solution, insoluble in the gasoline and not destroyed by the conditions at the treatment.

Various catalysts were tested to compare how much each speeded up the conversion reaction, how much mercaptan had to be left in the caustic soda solution to prevent the catalysts themselves from being consumed, and the effect of the catalyst on certain other compounds that are

added to the caustic solution to aid in dissolving the mercaptans.

It was found that some of the catalysts had definite advantages over the others in removing certain mercaptans, while the tannins also aided the caustic soda to remove the mercaptans from the gasoline.

Several technical advantages are claimed by the use of conversion catalysts. The use of these materials is said to lower the cost of regenerating the caustic soda solution. At present, many petroleum refiners are using another regenerating method employing steam at a higher temperature. It is claimed that the same equipment can be converted for use with catalysts, and that the lower operating temperature decreases corrosion and permits the use of ordinary steel equipment. In the method employing steam, the mercaptans are not converted and present an odor nuisance which is eliminated when catalysts are used.

J. Happel and S. P. Cauley, Socony Vacuum Oil Co., before Petroleum Division, American Chemical Society, Chicago, Sept. 10, 1946.

FLUORINE CHEMISTRY

THE FIELD of fluorine chemistry is at present only a small segment of the chemical industry. However, it is believed that this situation will change rapidly. Within the next few years, many new products should be available commercially which contain fluorine or have been produced by new processes involving fluorine.

In the field of organic chemistry, for example, there are many times more fluorine-containing compounds theoretically possible, even by present procedures, than there are known today. Because of the wide and rapidly expanding industrial and academic interest in such compounds many of these new substances will be made. Some are certain to find commercial applications.

The fluorine atoms in organic compounds containing not less than two fluorine atoms attached to a carbon atom are very firmly held. Hence, many stable compounds resistant to heat and chemical agents are possible. Also, the vapor pressure of a fluorine-containing organic compound approximates that of the parent substance. Further, fluoro-carbons of high molecular weight are possible. These characteristics are not common for the other halogens. In addition, and like the other halogens, compounds in which more than approximately one-half of the hydrogen atoms have been substituted by fluorine are generally non-flammable.

E. T. McBee, Purdee University, before Division of Industrial and Engineering Chemistry, American Chemical Society, Chicago, Sept. 11, 1946.

UNIT PROCESS FUNDAMENTALS

PAST instruction in organic unit processes has been characterized by the presentation of a vast number of "case studies" of industrial manufacturing methods, appropriately subdivided into various broad classifications on the basis of the major chemical reactions involved. Because of the inadequacy of the data available, little attempt has been made to correlate the many physiochemical factors which in-

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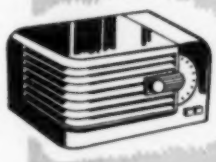
A versatile alcohol whose hydroxyl group and double bond both take part in reactions. Used in manufacture of resins, perfumes, flavorings, pharmaceuticals.



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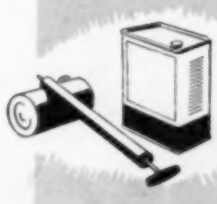
TERTIARY BUTYL

A stable water-miscible alcohol. High purity. Useful in extraction of drugs; as a coupling agent in manufacture of insecticides, disinfectants and industrial cleaners; denaturant; synthesis of resins, perfumes, germicides.



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High boiling solvent. Functions both as an alcohol and a ketone. Mild odor makes Diacetone especially suitable for interior brushing lacquers — nitrocellulose and cellulose acetate types. Component of hydraulic brake fluids.

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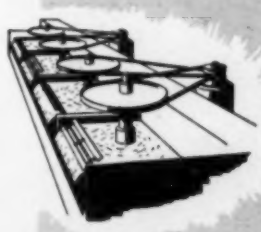
New high standard of purity increases the value of Isopropyl for formulation of hair tonics, shampoos, massage preparations, lotions, liquid soaps, emulsions, astringents and antiseptics. Likewise valuable in preparation of vitamins, biologicals and drugs.

METHYL ISOBUTYL CARBINOL

Moderate evaporation rate makes this alcohol a desirable latent solvent for nitrocellulose lacquers; resin solvent for phenolic type baking finishes . . . alcohol portion of a solvent for synthetic alkyd and urea-formaldehyde baking finishes. In combination with other materials, used as a frother in the flotation recovery of certain copper and zinc ores.



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fluence these chemical changes, and which largely determine the sequence of industrial operations.

In the light of recent advances in physical chemistry and physical-organic chemistry, a more fundamental approach to the unit process concept is warranted. It is suggested that (1) chemical and physical properties of matter as related to chemical constitution, (2) reaction kinetics and chemical change, (3) chemical thermodynamics, thermochemical phenomena, and thermodynamic properties, and (4) the principles of catalysis, solubility, etc., as related to the structure of matter should constitute the basis of unit process instruction.

A methodical consideration of the several processes, applying the above principles and discussing, simultaneously, the equal importance of materials of construction, equipment design, the unit operations, instrumentation, and economics can then follow.

Within the limits of modern knowledge of physical chemistry, present repeated recourse to empirical explanations and plant practice will thus be minimized, except where necessary or desirable.

Charles H. Prien, University of Colorado, before Division of Industrial and Engineering Chemistry, American Chemical Society, Sept. 9, 1946.

MINERAL RESOURCES OF USSR

Soviet Russia's mineral resources were one of the important factors in helping win the recent war with Germany and Japan. The principal resources are coal, iron and oil. There are more than 25 coal basins distributed over the entire country, containing all the types of coal needed for domestic industries. The Donetz basin has been under exploitation for over 100 years, but when it was occupied by German troops, new areas were developed, the largest of which is the Petchora basin. Its reserves are ten times that of the Donetz basin. Another new region was discovered, the Tungus basin, which has been estimated to be equal to one-half of the world's potential supply of coal.

The greatest iron deposits are found in the Dneiper River valley, the second most important are around Magnitogorsk, and the third is the Kuznetsk region. The present goal is to bring the annual production of steel to a minimum of 60,000,000 tons.

The old oil fields are located at Baku, but new and very rich deposits were found along the eastern shores of the Volga river, as well as several other regions.

Deposits of tungsten and molybdenum have been found in the Caucausus. Nickel and cobalt, manganese, tantalum and niobium are also plentiful. In recent years, chromium deposits were discovered near Aktubinsk in the South Ural Mountains which contain about 80 percent of the world's supply of chromium. Soviet Russia is particularly rich in copper and there are numerous deposits of lead and zinc. One of the most important recent discoveries is that of rich deposits of tin. There have also been new discoveries of aluminum, and there are a number of magnesium deposits. There are rich sources of platinum, palladium and iridium, and Soviet Russia is second to Great Britain in her production

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of gold. Much work has been done on uranium but since this is a military secret, it cannot be disclosed.

S. P. Alexandrov, Institute of Non-Ferrous Metals and Gold, Moscow, before non-participating scientists, USS Panamint, Operation Crossroads, August 1946.

TOXICITY HAZARDS OF BURNING PLASTICS

No new hazard has been introduced into the work of firemen by modern synthetic resins and plastics. A number of toxic gases may be produced by the destructive distillation or partial combustion of plastics, but all of these with one exception—hydrogen chloride—are also produced by the partial combustion of such familiar materials as wood, leather, silk, wool and fats. All of these, as well as the plastics, give carbon monoxide as the major product of partial combustion. This gas still constitutes the chief hazard to fire fighters exposed to the fumes from a smoky, smoldering fire. Other toxic gases, given off by both plastics and the older, more familiar materials are normally produced in small concentrations as compared with that of carbon monoxide.

The important toxic gases which may be produced from both old and new materials are formed only under the same conditions as dense smoke, and—again with exceptions—are destroyed in a freely burning flame. The fumes so produced may include formaldehyde, hydrogen cyanide, hydrogen sulphide, ammonia, acrolein and carbon monoxide, all of which are converted into harmless products in the complete combustion of a free flame. Hydrogen chloride or the chlorine formed from it (products of certain vinyl and vinylidene resins) and sulphur dioxide (from rubber and wool) are not burned to harmlessness in a free flame and the only way to get rid of them is to flush them away with a draft to the outside air. Such a draft serves the dual purpose of helping burn up some toxic compounds and of flushing out others.

We hear a great deal about the dangers of new materials, when the fact is that the oldest plastic, celluloid, is the most hazardous and the newest, the silicones, melamines and Teflon, are the safest.

Foster Dee Snell, Foster D. Snell, Inc., before Michigan Fire College, Ann Arbor, June 26, 1946.

OCTANE IMPROVEMENT PROCESSES

Although it is generally realized that the average automobile on the road today is not designed to appreciate better fuels than those now produced, it appears that future competition will continue to force motor fuel octane numbers upward.

Leaded octane ratings of the total gasoline produced from a barrel of crude oil can be improved by at least three well known methods, listed approximately in the order of increasing capital cost to the refiner: (1) Desulphurization of gasoline, (2) conversion of gasoline hydrocarbons by reforming, and (3) conversion of hydrocarbons heavier than gasoline by cracking.

Polymerization or alkylation of the gases produced by cracking or reforming may be classified as complementary processes which also increase the octane rating of the total gasoline blend.

Mercaptan sulphur can be removed from

straight run or cracked gasoline either by extraction or catalytic conversion to another sulphur compound, such as hydrogen sulphide, which may be easily eliminated.

Thermal reforming is the conventional process used for improving the octane rating of straight run fractions. At the present time a considerable amount of research work is being done on the catalytic conversion of hydrocarbons normally boiling in the gasoline range. In most cases the octane improvement obtained is a result of both desulphurization and a change in the structure of the hydrocarbons. Thermal reforming plus catalytic polymerization of the gases produced is the yardstick by which most of these catalytic reforming processes are evaluated. In order to be attractive the catalytic process must produce an octane number considerably better than the thermal reforming and polymerization operations, for which some refiners are presently equipped.

Comparisons of thermal and catalytic cracking of heavier stocks show an advantage of 8-10 units in the octane rating of the gasoline produced from catalytic cracking, with little difference in the installation and operating costs for the two processes. However, the installation costs per barrel of gasoline produced are higher for either thermal or catalytic cracking than for any of the processes previously discussed.

If it is believed that only a slight increase in motor gasoline octane numbers should be expected in the future, such processes as uniforming and isoforming, which convert gasoline hydrocarbons, may be advantageous. If on the other hand it is necessary to produce 80 octane regular and 85 octane premium gasoline, these gasoline conversion processes must be considered at the present time only as stop-gap measures when applied to the refining of low sulphur mid-continent crude oil.

Davis Read, Universal Oil Products Co., before Wichita Section, American Chemical Society, June 6, 1946.

RESEARCH POTENTIALS OF PETROLEUM

AMERICA'S oil industry is at the crossroads, as a result of the rapid growth of its synthetic chemical branch. The industry is confronted with the problem of whether or not its individual operators want to get into entirely new industries with the great diversification of sales outlets and the attendant problems. In other words, the petroleum industry has had an entirely new vista opened to it. The exclusive operations of the past are now only a small part of the over-all picture.

Compared with the the slower development of other industries, progress to date in this field of chemical utilization of natural gas and petroleum is amazing when it is considered that practically all the know-how developed since 1930. However, this development is just an indication of the fruitfulness of research in this field. The surface has only been scratched.

Not only the industry but its production centers will undergo great changes as a result of advances in the synthetic field. It is a basic principle of industrial economics that when basic materials in quantity such as organic synthetic chemicals, as produced from natural gas, are made available in a given area numerous supplemental industries

utilizing these products as raw materials spring into being with a resulting industrial expansion of over-all benefit to the area. Plastic, textile, tanning and a host of other types of factories thus go into areas where they have not previously been found.

Aside from the development of synthetic products, research can aid the industry by evolving new techniques and procedure to improve exploration methods and thus increase known reserves. One exceedingly fruitful field is research for getting greater extration from wells, and it is interesting to note the increasing number of wells long since abandoned that have been returned to successful operation through new techniques of extraction.

Improved transportation and distribution methods, as well as better operating techniques in processing plants, also can be developed by research.

Harold Vagtborg, Midwest Research Institute, before Wichita Section, American Chemical Society, June 1946.

FOREIGN LITERATURE ABSTRACTS

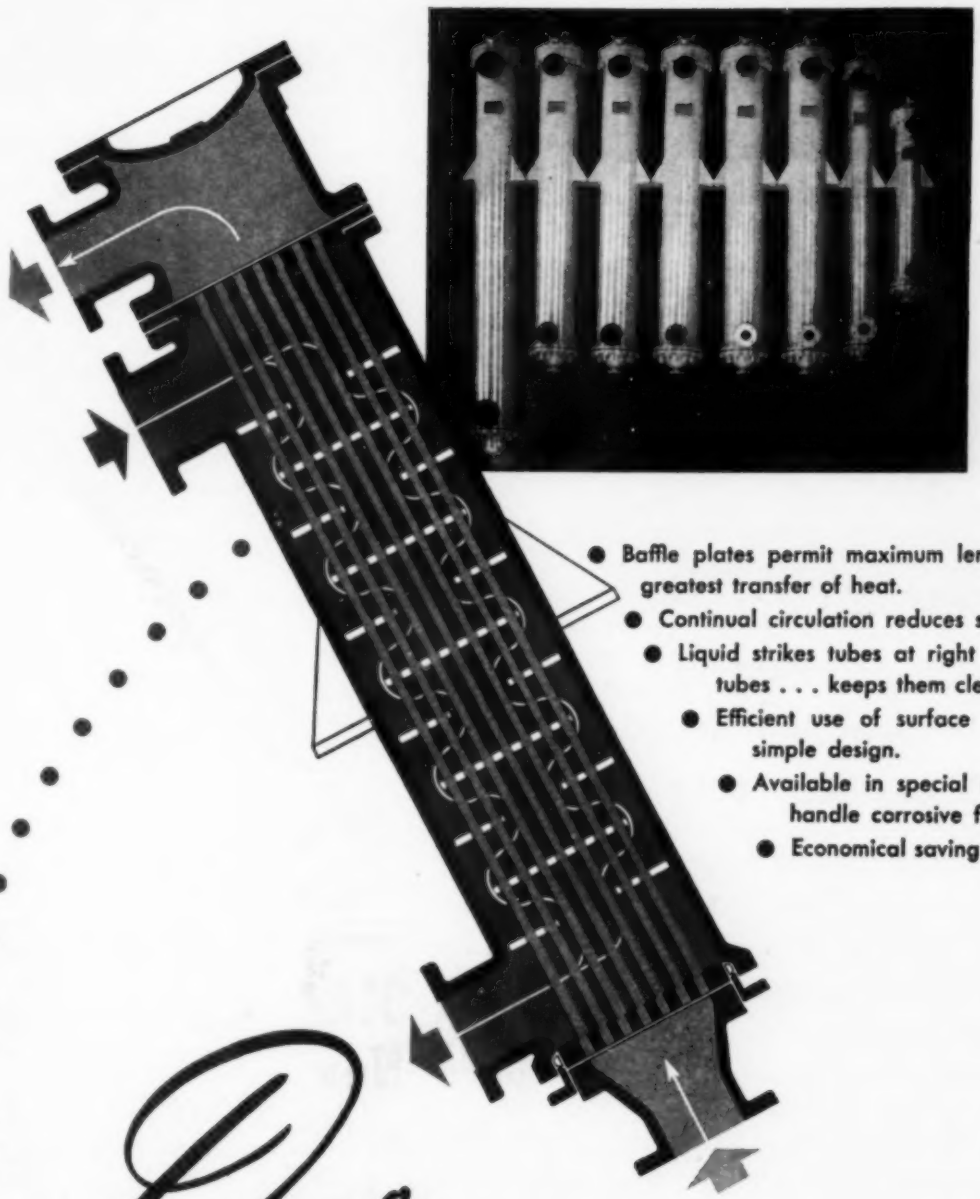
DI- AND TRI-ISOCYANATE COMPOUNDS

DI- OR POLY-ISOCYANATES react with polyhydroxy compounds to form polyurethanes, the di-compounds usually forming linear polyurethanes while the tri- and higher compounds give rise to compounds with lateral chains. An infinite variety of properties can thus be obtained by varying the constituents. The di- and tri-isocyanates produced by the I. G. Farbenindustries at Leverkusen and Elberfeld were given the tradenames of Desmodur and Desmosit. Desmodur *T* is the di-isocyanate of toluene, with a molecular weight of 174. Its production was 20 tons per month. Desmodur *H* is the di-isocyanate of hexamethylene, and its production was 6-8 tons per month. Desmosit *C* is 1-chlorophenylene-2,4-di-isocyanate. The di- and tri-isocyanates are used chiefly to produce polyurethanes, but they are also used in tanning, cutting this operation down from 80-100 hr. to 7 hr.; they are used for treating acetate silk to prevent its melting during ironing; and Desmodur *R* is used to give adhesive properties to synthetic rubber.

Digest from "Some New Plastics Manufactured by the I. G. Farbenindustrie at Leverkusen and Elberfeld," by F. J. Curtis, *Chimie et Industrie* 55, No. 6, 436-438, 1946. (Published in France.)

ZINC-CHROMIUM CATALYSTS

ZINC-CHROMIUM catalysts were prepared by moistening zinc oxide, alone or mixed with chromic oxide, with a 50 percent solution of chromium trioxide, grinding, drying at 110 deg. and pelleting. The chromium trioxide solution was treated with methanol added drop by drop until there was no further reduction of hexavalent chromium. It was found that substitution of chromium oxide by chromium



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trioxide produces an approximately 40 percent rise in the efficiency of the catalyst without affecting the composition of the methanol mixture. Practically no difference was observed in the catalysts $8ZnO.3CrO_3$ and $2ZnO.CrO_3$ when they were prepared from technical oxides, but there is a sharp drop in the activity when the chromium content is increased to a composition of $ZnO.CrO_3$. Since a catalyst of the same composition but prepared by evaporating an ammonium carbonate solution of the same components showed approximately twice as much activity, the reduced activity of the former catalyst was believed to be due to its non-homogeneous structure resulting from the method of preparation when using technical zinc oxide and chromium trioxide. The activity of the catalyst was not increased by substitution of these oxides by an ammonium carbonate solution of them, whether using partly reduced or unreduced chromium, or substituting zinc oxide with zinc carbonate. The activity and mechanical strength of the catalyst is increased considerably by repelleting it, which involves reduction, after a short period of work. The activity of the spent catalyst can be restored completely by the addition of 1 to 2 mols of chromium trioxide per 8 mols of zinc oxide, and repelleting.

Digest from "A Study of Zinc-Chromium Catalysts for Synthesis of Methanol," by V. M. Grinevich, *Zhurnal Prikladnoi Khimii* 18, 90-96, 1946. (Published in Russia.)

HIGH-TEMPERATURE LUBRICATION

Under normal operation, there is a formula which makes it possible to determine fairly definitely the quantities of oil necessary for lubrication of cylinders of internal-combustion engines:

$$Q = S(P)^{0.5}(T/450)^{5.75}/1,000$$

in which Q is the quantity of oil in grams used per hour for lubrication of the cylinder (packing not included), S is the surface swept by the piston during one hour of operation, E is the absolute temperature of the film of oil, P is the value in kilograms of the mean ordinate. Laboratory procedure is indicated which helps in the ready selection of oils for each particular case under consideration. The necessary apparatus includes a small oven automatically controlled at 350 deg., a series of aluminum disks perfectly polished with a burnisher (diameter 110 mm., thickness 3 mm.), a needle with a diameter of 3 mm. ending in a point for forming drops of approximately 30 cu.mm., intense illumination at the back of the oven making visible the outside of the disks used in the test. The test consists in measuring with a chronometer the time taken by the drop to coat the surface of the disk, then observing the appearance and the consistency of the spread oil (thickness: 0.005 mm.). A note is also made of the stains, the deposits of carbon, the clearness of the oil, etc.

Digest from "New Approximations on the Lubrication of Surfaces Kept at Very High Temperatures," *Rev. Ind. Minerale* No. 496, 71-80, 1945. (Published in France); *Chimie et Industrie* 55, No. 4, 271, 1946.

CHEMICAL ENGINEER'S BOOKSHELF

LESTER B. POPE, Assistant Editor

CONCISE

WATER TREATMENT AND PURIFICATION. *Second Edition. By William J. Ryan. McGraw-Hill Book Co., New York,* 270 *pages.* $2.75.

Reviewed by Sheppard T. Powell

THE REVISED edition of this book, should prove to be a valuable supplement to the earlier work prepared by the author. The book contains a concise description of the various types of water treatment processes in general use today, including the purposes for which each system may be applied most successfully.

The language is simple, but an informative and theoretical discussion has been limited in favor of more practical data based on operating experience. Boiler feedwater treatment has been given a place comparable with other water treatment processes.

Also included is an especially complete bibliography which will serve as a helpful guide to those who may wish to refer to original manuscripts or other texts. The book is recommended for the libraries of engineers, managers, operators and others who wish a concise reference on water treatment problems.

TEMPORARY

MODERN CHEMISTRY (SOME SKETCHES OF ITS HISTORICAL DEVELOPMENT). *By A. J. Berry. Cambridge University Press.* 240 *pages. Price* $2.50.

Reviewed by F. C. Nachod

MOST of us are agreed that very little attention is paid to the historical side of chemistry. And most of us would like to have the opportunity to gain some understanding of the historical evolution of our field, a part of training which is generally most sadly neglected in our universities and colleges. Mr. Berry is aware of this apparent lack of historical perspective and has written a selection of essays on some phases of the history of chemistry without the claim for complete coverage. The chapters are entitled: classical atomic theory; electrochemistry; stereochemistry; radioactivity; elements isotopes and atomic numbers; some experimental studies on gases; some problems of solutions; some essential features of chemical change. The last chapter is called retrospect.

"Modern Chemistry" is a very misleading title. The author stops short of "modern chemistry" by about ten to twenty years. His little book is not written with inspiration and some parts make decidedly dull reading. Yet there is nothing that would fill the existing gap, and Mr. Berry's sketches appear to be no more or less than a temporary and not quite sufficient ersatz article.

SURVEY

RUBBER IN ENGINEERING. *Chemical Publishing Co., Brooklyn.* 267 *pages.* $5.50.

Reviewed by A. R. Kemp

"RUBBER in Engineering" furnishes a good survey of information on the fundamental physical and mechanical properties of rubber. Although many of the articles used have appeared in technical publications, the integration of them in book form enhances their values. Chapters 4, 13, 14 and 16 dealing with properties of rubber are particularly useful.

Although rubber technologists may not find much new information in the book, it is a brief and adequate summary of rubber from the viewpoint of the users and should prove to be interesting and valuable to engineers presented with rubber problems involving design and choice of suitable specification requirements.

PHYSICAL TESTS

PHYSICAL METHODS OF ORGANIC CHEMISTRY. *Vol. II. Edited by Arnold Weissberger, Interscience Publishers, New York.* 631 *pages.* $8.50.

THE SECOND volume of this organic reference is now available. It continues the presentation along the same lines and with the same quality as the first which was published last year. (See *Chem. & Met.*, Nov. 1945, p. 286.) Ten chapters by leading authorities cover spectroscopy, colorimetry, polarimetry, conductometry, potentiometry, polarography, mass spectrometry, and determinations of dipole moments, magnetic susceptibility and radioactivity. Volume I was described on these pages as a "significant contribution to the field of organic chemistry." This applies now to two volumes. Together they provide an authoritative background for understanding and evaluation of physical tests.

The subject index in Vol. II covers both volumes.

RECREATED VARNISHES

VIOLIN VARNISH. *By Joseph Michelman. Published by the author,* 5050 *Oberlin Blvd., Cincinnati, Ohio.* 185 *pages.* $3.75.

Reviewed by Joseph J. Mattiello

THE AUTHOR's subtitle of this book is "A Plausible Re-Creation of the Varnishes Used by the Italian Violin Makers Between the Years 1550 and 1750, A. D." This reviewer was at first interested in this subtitle and questioned the temerity of the author to recreate varnishes which were applied to violins (wooden surfaces) several hundred years ago. He had no wet samples available for comparative investigation and even if he had any such samples, their authenticity would certainly be questioned. But, when reading this book the reviewer was certainly fascinated by the author's approach in recreating the varnishes. He has conducted extensive researches into the literature on the subject and then proceeded to formulate varnishes on a quantitative basis. The logic he has applied in determining the kind of varnish the ancients made was guided by the chronology of the literature on the subject and the raw materials available to the ancients. He points out that two types of varnishes were used; the subvarnish for priming and the color varnish as the finishing varnish. His researches in their formulation (recreating) the violin varnishes has extended over a period of eight years or more. Although these varnishes are primarily composed of metal resinates, turpentine, linseed oil and coloring matter, they are not to be considered as oil varnishes in the modern sense. They are merely turpentine resin solutions to which linseed oil is added as a plasticizer. The varnishes were all prepared at ordinary room temperature.

The author's research extended to application of the varnishes to violins. The subvarnishes were composed of aluminum rosinate, turpentine and linseed oil; while the color varnishes were represented by a brown iron rosinate varnish, an orange aluminate rosinate varnish and a red rosinate varnish. If the ancients did make the metal resinate as indicated by this author, then they made the first so-called synthetic resin.

Madder, dragons' blood, gum gamboge, aloes, socotrine, brazilwood, logwood, etc., have also been considered as coloring agents.

It is interesting to note that the total application of subvarnish and color varn-

RECENT BOOKS RECEIVED

Developing Your Executive Ability. By H. Smith. McGraw-Hill. $2.50.

Ducktown Back in Raht's Time. By R. E. Barclay. University of North Carolina Press. $5.

The Engineer at Law. By C. B. & J. R. McCullough. The Iowa State College Press. $6.

English-French and French-English Technical Dictionary. By F. Cusset. Chemical. $5.

Industrial Carbon. 2nd ed. By C. L. Mantell. Van Nostrand. $7.50.

The Life of a Chemist: Memoirs of Vladimir Ipatieff. Ed. by X. J. Eudin, H. D. Fisher & H. H. Fisher. Stanford University Press. $6.

The Metallurgy of Quality Steels. By C. M. Parker. Reinhold. $6.

Organic Chemistry. 2nd English ed. By Paul Karrer. Elsevier. $7.50.

Physical Chemistry for Colleges. 6th ed. By E. B. Millard. McGraw-Hill. $4.50.

Scientific Instruments. Ed. by H. J. Cooper. Chemical. $6.

Transportation Principles and Problems. By T. C. Bigham. McGraw-Hill. $5.

ish on the violins in this investigational work varied from 14 to 20 coats, the former varied from 6 to 7 coats, while the latter from 8 to 13 coats. The author further points out that the total film thickness of a large number of actual tests varied from 0.0015 to 0.0052 in., which values are comparable to the thinness of newspaper, 0.0030 in.

This whole book may be considered as an interim report, since the author has not completed all his aging tests of the varnishes applied to the violins. It will certainly be interesting to follow the results of these tests. The author may also decide later to approach this subject from another angle. He may give further consideration to the idea that the ancients were acquainted with the fact that boiled linseed oil acquired desirable properties such as increased viscosity, increased drying time rate and improved durability.

Specifically the subject matter is divided into 18 chapters, covering a critical review of previous publications, formulation of earliest varnishes, the chemistry of the varnishes, his own researches in the formulation of colored varnishes, preliminary treatment of wooden surfaces, varnishing, drying and polishing, a discussion of other resins, soaps, old coloring agents, alizarine as a coloring agent, and ending with a transitional discussion from past to present.

The author deserves a great deal of credit for tackling a subject of such a nature that no matter what approach he used he would be open to criticism. The results of this author contribute to the solution of the problem, but he frankly points out that more research will have to be conducted to complete the solution of the violin varnishes.

This book should be of interest and value to the technical and non-technical members of the protective and decorative coating field, and of historical interest to everyone.

RECENT BOOKS and PAMPHLETS

Collected Abstracts Published During 1945 on Spectrochemical Analysis. Compiled by Edwin S. Hodge. Distributed by Ohio Valley Spectrographic Society, Engineers Club Bldg., Dayton, Ohio. 57 pages. $1. Verbatim copy of all the abstracts published by "Chemical Abstracts" during 1945.

The Aluminum Industry. By Stanley V. Malcuit. Published by Bellman Publishing Co., 83 Newbury St., Boston 16, Mass. 36 pages. $1. History of the industry, processes, fabrication, marketing, typical jobs and other vocational guidance information.

Cementing and Assembly of Plastics. Advance chapter No. 5 of SPI Handbook, published by The Society of the Plastics Industry, 295 Madison Ave., New York 17, N. Y. 44 pages. Recommended techniques. Includes a comprehensive listing of sources of materials.

From the Research Laboratory to the Armed Forces. Published by Mellon Institute, Pittsburgh, Pa. 32 pages. Six radio talks by Mellon fellows describing essential research programs.

Sulfuric Acid. Series 4 of "Controlling Chemical Hazards," published by Division of Labor Standards, U. S. Department of Labor, Washington 25, D. C. 24 pages. Proper handling and storage of drums and carboys, protective clothing and equipment, first aid, and employee training.

The Problem Children of Technology and Banking. By R. P. Soule, American Machine &

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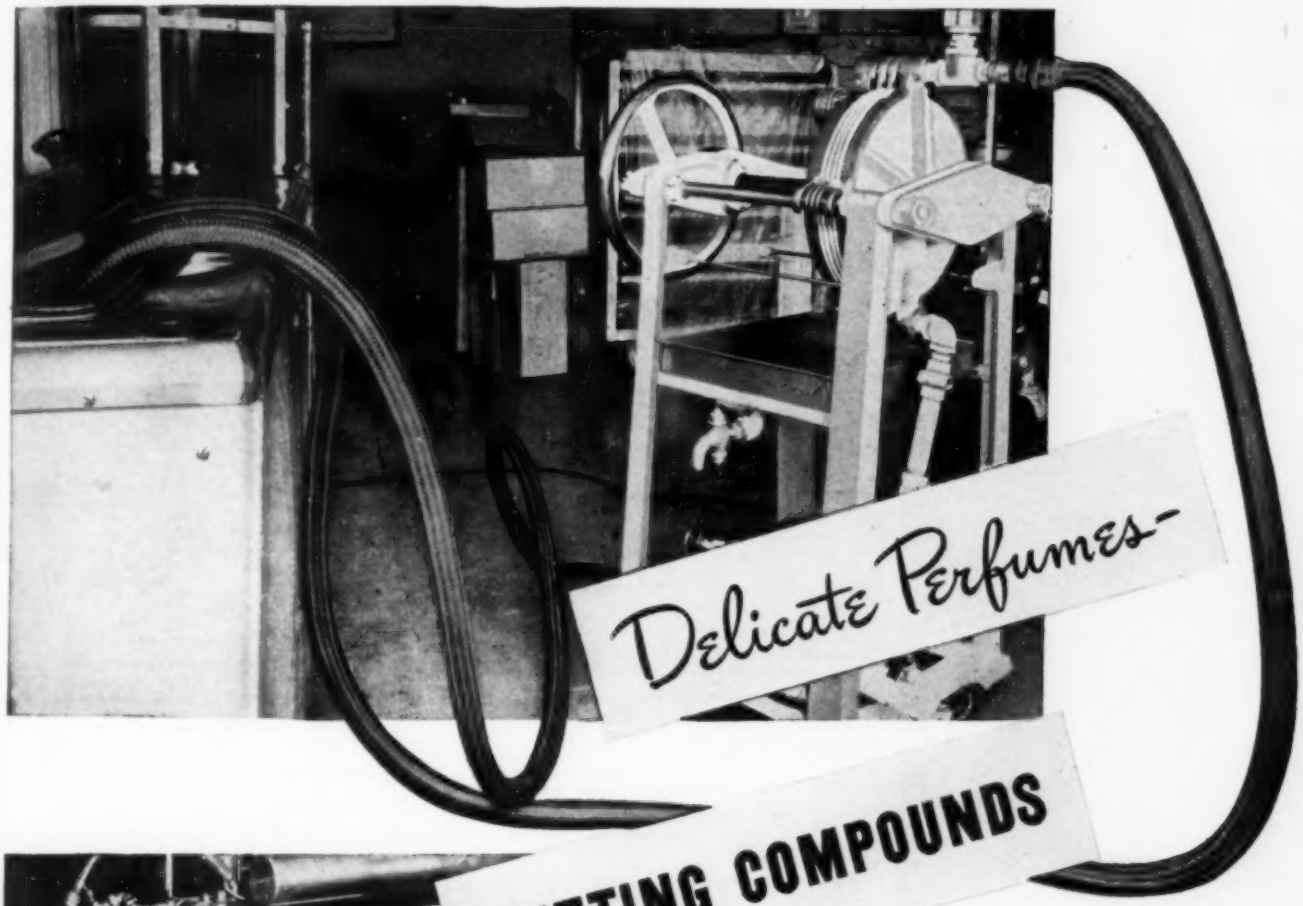

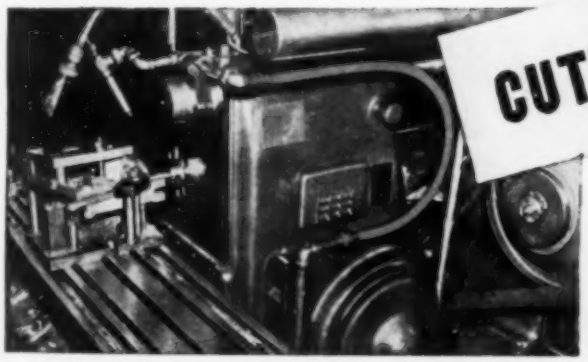

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New Toronto, Ont.

Foundry Co., 511 Fifth Ave., New York, N. Y. 28 pages. Gratis. Reprint of an address before the Society of Chemical Industry in New York February 21.

A Humanistic-Social Overhauling. By Clement J. Freund, dean, College of Engineering, University of Detroit, Detroit 21, Mich. Account of an attempt by the faculty of the University of Detroit to improve the curriculum. Reprinted from **Jour. of Engineering Education**, Dec. 1945, pp. 284–291.

Economic Base for Power Markets in Lane County, Ore. Published by Bonneville Power Administration, Portland 8, Ore. 67 pages. A survey appraising the prospects for electric power consumption in the Pacific Northwest. Covers the physical base, people and their incomes, production and employment, public facilities and finance. Contains maps, graphs, photographs and appendix tables.

Researches of Mellon Institute. Published by Mellon Institute of Industrial Research, University of Pittsburgh, Pittsburgh 13, Pa. 13 pages. Gratis. Thirty-third annual report reprinted from "Chem. & Eng. News."

Year Book. Published by American Standards Association, 70 East 45th St., New York 17, N. Y. Gratis. First edition since 1938. Lists officers and directors of the board of directors, standards council, and other committees. Also carries constitution and by-laws, information about the organization and how standards are developed. Approved standards and projects under development are listed.

The Illinois State Geological Survey in War Mineral Research. By M. M. Leighton, chief of the Division of the State Geological Survey, Urbana, Ill. 23 pages. Annual report.

Report of Conference on Post-War Preparation and Packing of Rubber. Published by Imperial Institute, London, S.W.7, England. 31 pages. Includes a paper on the large scale manufacture of standard smoked sheet rubber.

The Alkylation of Alkanes. By Gustav Egloff and George Hulla, Universal Oil Products Co., Chicago, Ill. 67 pages. Catalytic and thermal alkylation, summary of the products of alkylation, and mechanism of alkylation.

Fine Powders and Particles in Industry. By M. Pirani and W. J. Kramers. Published by The British Coal Utilisation Research Association, 13 Grosvenor Gardens, London, S.W.1, England. 16 pages. Survey of the properties, methods of production, particle-size measurement, and field of application, of powders and materials containing such fine particles, with special reference to the particle sizes of the powders employed.

Industrial Experimentation. By K. A. Brownlee. Published by His Majesty's Stationery Office, York House, Kingsway, London, W.C.2, England. 116 pages. 2s. Monograph intended to provide a guide to modern statistical methods, both the use of tests of significance to attain reliability in deductions from experimental data and the use of statistical design to attain maximum precision with minimum expenditure.

Development Department, The Solvay Process Company, Nitrogen Division. 26 pages. Booklet describing the functions and interests of engineers, chemists and other scientific and technical personnel of the development department at Hopewell, Va.

Bibliography of the Geology and Natural Resources of North Dakota, 1814-1944. By C. E. Budge. Bulletin No. 1, published by North Dakota Research Foundation, Bismark, N. D. 214 pages. Bibliography, author index, subject index, and appendixes of North Dakota state officials, engineers and geologists.

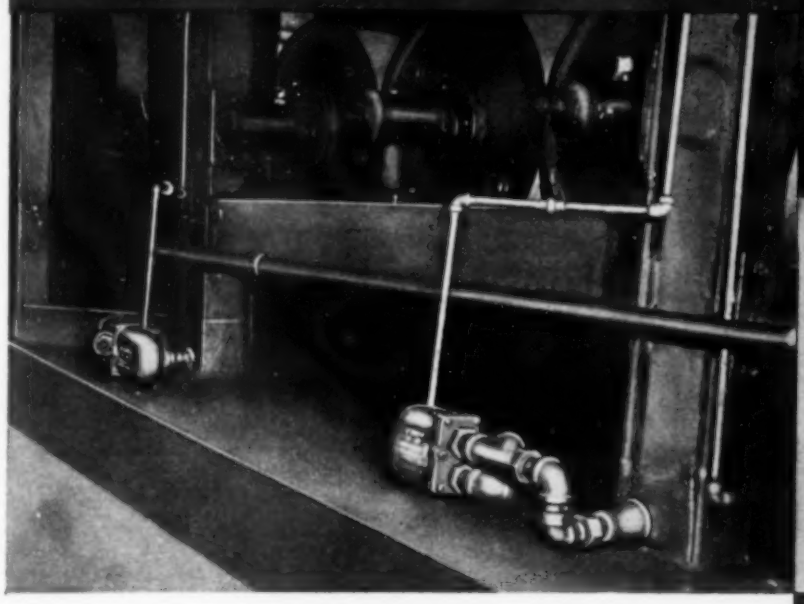
Standard Code for Arc and Gas Welding in Building Construction. Published by American Welding Society, 33 West 39th St., New York 18, N. Y. 68 pages. 50 cents. Design of welded connections, filler metal, workmanship, inspection and qualification. Appendixes list definitions, welding symbols, welded joints, qualification of procedures and operators, illustrated profiles.

Enzymes and Their Role in Wheat Technology. Edited by J. A. Anderson. Interscience Publishers, Inc., 215 Fourth Ave., New York 3, N. Y. 371 pages. $4.50. First in a projected series of monographs sponsored by the American Association of Cereal Chemists. Amylases esterases, proteases, yeast fermentation and other topics of interest to cereal chemists.

Industrial Directory of Berkeley, Calif. Published by Berkeley Chamber of Commerce, 100 Berkeley Square, Berkeley 4, Calif. 78 pages. A mimeographed volume containing a complete alphabetical listing of manufacturers and their products, including listing of firms by types of products.

Reconnaissance Geology of Limestone Deposits in the Willamette Valley, Ore. G. M. I. Short Paper No. 15, published by Dept. of Geology and Mineral Industries, 702 Woodlark Bldg., Portland, Ore. 17 pages. 15 cents. Contains description and analyses of deposits examined, including summary of findings, tables and maps. Mimeographed.

Dyeing AND *Drying*



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Rotating cylinders as used in the paper and textile industries accumulate heavy condensate if not properly drained and vented. If any cylinder lags behind others—the material sags on one side, stretches until it breaks on the other. Hours are lost in starting up again.

Sarco FT Steam Traps with H Air Vents at the top settled this problem in a large textile plant in Brooklyn. Sarco TR 21 Temperature Controls are used on the dye vats which immediately precede the drying operation.

This job was engineered by the local Sarco representative. The cost was negligible compared to the results obtained.

Adequate removal of condensate and air, and satisfactory temperature control can provide that added margin of profit in any industry using steam. The combined advantages of faster work, fewer stoppages and rejects and less fuel will work for you every hour.

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143

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GOVERNMENT PUBLICATIONS

The following recently issued publications are available at prices indicated from the Superintendent of Documents, Government Printing Office, Washington 25, D. C. In ordering any publications noted in this list always give complete title and the issuing office. Remittances should be made by postal money order, coupons or check. Do not send postage stamps. All publications are in paper cover unless otherwise specified. When no price is indicated, the pamphlet is free and should be ordered from the bureau responsible for its issue.

Preparation of Ammonium Nitrate for Use as a Fertilizer. By William H. Ross, et al. Department of Agriculture, Technical Bulletin No. 912. Price 20 cents.

Fertilizers and Lime in the United States. Department of Agriculture, Miscellaneous Publication No. 586. Price 20 cents.

Rubber. First and Second Reports of the Inter-Agency Policy Committee on Rubber. Combined printed copy of previously mimeographed first and second reports. Office of War Mobilization and Reconversion. Price 20 cents.

The Integration of Surplus Disposal. Quarterly Progress Report to Congress by War Assets Administration. First Quarter 1946. Price 20 cents.

The Acceleration of Surplus Disposal. Quarterly Progress Report to Congress by War Assets Administration. Second Quarter 1946. Price 20 cents.

Report to Congress on Foreign Surplus Disposal. July 1946. Office of the Foreign Liquidation Commissioner. Department of State Publication 2571. Price 15 cents.

Economic Controls and Commercial Policy in Panama. U. S. Tariff Commission. Price 10 cents.

Recent Developments in the Foreign Trade of Colombia. U. S. Tariff Commission. Price 15 cents.

Chemical Engineering as a Profession. Vocational Booklet No. 3. National Roster of Scientific and Specialized Personnel. Price 10 cents.

Small-Scale Tests of Selective Reduction of Iron in Titaniferous Iron Ores. By R. J. O'Dea. Bureau of Mines, Report of Investigations R. I. 3886. Mimeographed.

Routine Quantitative Analysis by X-Ray Diffraction. By James W. Ballard and H. H. Schrenk. Bureau of Mines, Report of Investigations R. I. 3888. Mimeographed.

Characterization of Light Oil. Part V of Hydrogenation and Liquefaction of Coal. By E. H. Kaplan, et al. Bureau of Mines, Technical Paper 690. Price 10 cents.

Carbonizing Properties of Eagle-Bed Coal from Prospect Shaft, Carbon, Kanawha County, W. Va. By D. A. Reynolds, et al. Bureau of Mines, Technical Paper 691. Price 15 cents.

A Study of Anodes for Electrolytic Manganese. By David Schlain, et al. Bureau of Mines, Report of Investigations R. I. 3863. Mimeographed.

Thermodynamic Properties of Ilmenite and Selective Reduction of Iron in Ilmenite. By C. H. Shomate, et al. Bureau of Mines, Report of Investigations R. I. 3864. Mimeographed.

Effect of Impurities on the Electrodeposition of Manganese. By David Schlain, et al. Bureau of Mines, Report of Investigations R. I. 3872. Mimeographed.

The Recovery of Metal and Other Valuable Products from Aluminum Dross. By O. C. Garst, et al. Bureau of Mines, Report of Investigations R. I. 3874. Mimeographed.

Exploration of Eagle Mountain Fluorspar Deposits, Hudspeth County, Tex. By W. E.

Dennis. Bureau of Mines, Report of Investigations R. I. 3878. Mimeographed.

Exploration of the Packard Fluorspar Property, Gila County, Ariz. By J. B. Cummings. Bureau of Mines, Report of Investigations R. I. 3880. Mimeographed.

Limits of Inflammability and Ignition Temperatures of Naphthalene. By G. W. Jones and G. S. Scott. Bureau of Mines, Report of Investigations R. I. 3881. Mimeographed.

Wartime Progress in Coke Production. By William Seymour. Bureau of Mines, Report of Investigations R. I. 3907. Mimeographed.

Tests of Bituminous-Anthracite Mixtures on Industrial Stokers. By J. F. Barkley, et al. Bureau of Mines, Report of Investigations R. I. 3916. Mimeographed.

Effect of Relief Vents on Reduction of Pressures Developed by Dust Explosions. By Irving Hartmann and John Nagy. Bureau of Mines, Report of Investigations R. I. 3924. Mimeographed.

Control of Bulk Densities in Coke Ovens: Studies on Precision and Application of Various Testing Methods. By H. S. Auvil, et al. Bureau of Mines, Report of Investigations R. I. 3935. Mimeographed.

Blending Properties of Low- and Medium-Volatile Coals as Determined in the BA-AGA Apparatus. By D. A. Reynolds and J. D. Davis. Bureau of Mines, Report of Investigations R. I. 3936. Mimeographed.

European Shale-Treating Practice. By Wm. W. Odell and E. L. Baldeschwieler. Bureau of Mines, Information Circular I. C. 7348. Mimeographed.

A Plan of Training Mine Officials in Rescue Organization and Disaster Prevention. By E. R. Maize and J. V. Berry. Bureau of Mines, Information Circular I. C. 7353. Mimeographed.

A Study of Fault Determinations by Geophysical Methods in the Fluorspar Areas of Western Kentucky. By F. W. Lee and S. J. Hemberger. Bureau of Mines, Report of Investigations R. I. 3889. Mimeographed.

Automatic Water Heating, Utilizing Subbituminous Coal. By V. F. Parry, W. S. Landers, and J. B. Goodman. Bureau of Mines, Report of Investigations R. I. 3890. Mimeographed.

Helium Tracer Studies in the Elk Hills, Calif., Field. By E. M. Frost, Jr. Bureau of Mines, Report of Investigations R. I. 3897. Mimeographed.

Exploration of the Avon Mica District, Latah County, Idaho. By Glen C. Reed. Bureau of Mines, Report of Investigations R. I. 3898. Mimeographed.

Improved Apparatus and Procedure for the Determination of Helium in Natural Gas. By E. M. Frost, Jr., Bureau of Mines, Report of Investigations R. I. 3899. Mimeographed.

Gasification of Lignite and Subbituminous Coal Progress Report for 1944. By V. F. Parry, et al. Bureau of Mines, Report of Investigations R. I. 3901. Mimeographed.

Exploration of the White Eagle Fluorspar Mine, Cooks Peak Mining District, Grant County, N. Mex. By John H. Soule. Bureau of Mines, Report of Investigations R. I. 3903. Mimeographed.

Extinction of Propane and Butane Flames by Dichlorodifluromethane. By G. W. Jones and F. E. Scott. Bureau of Mines, Report of Investigations R. I. 3908. Mimeographed.

Active List of Permissible Explosives and Blasting Devices Approved Previous to December 31, 1945. By J. E. Tiffany and Z. C. Gaugler. Bureau of Mines, Report of Investigations R. I. 3910. Mimeographed.

Electrolytic Manganese in Low-Carbon Steel Tests at the Stanley Works, Bridgeport, Conn. By F. Sillers, Jr. and R. T. C. Rasmussen. Bureau of Mines, Report of Investigations R. I. 3911. Mimeographed.

The Metallurgical Research Program of the Bureau of Mines Relating to Iron and Steel. By R. S. Dean. Bureau of Mines, Report of Investigations R. I. 3920. Mimeographed.

Exploration of the Elk Mountain Mica Deposit, San Miguel County, N. Mex. By Ray J. Holmquist. Bureau of Mines, Report of Investigations R. I. 3921. Mimeographed.

National Motor-Gasoline Survey, Winter

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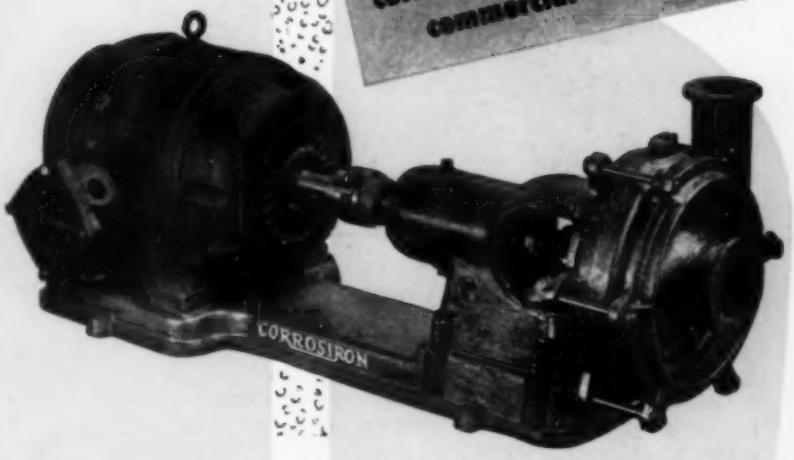
CORROSIRON resists the corrosive action of more acids than any other commercial alloy.

CORROSIRON is more resistant to acid corrosion than any other commercial alloy.



CORROSION AND ABRASION RESISTANCE—Corrosiron is a high silicon iron. It is not only remarkably resistant to corrosion, but is also extremely abrasion resistant, having a hardness of 300 Brinnell. It is unexcelled for handling corrosive liquids carrying abrasive solids.

INGENIOUS ENGINEERING—The brittleness and low tensile strength characteristics of high silicon irons pose unusual problems in engineering a centrifugal pump. But special care and the ingenious application of many years of experience provide the solution. These new BJ Corrosiron Acid Pumps are engineered for years of heavy-duty, trouble-free operation.

WE INVITE INQUIRIES about the application of BJ Corrosiron Acid Pumps to the pumping of corrosive liquids.

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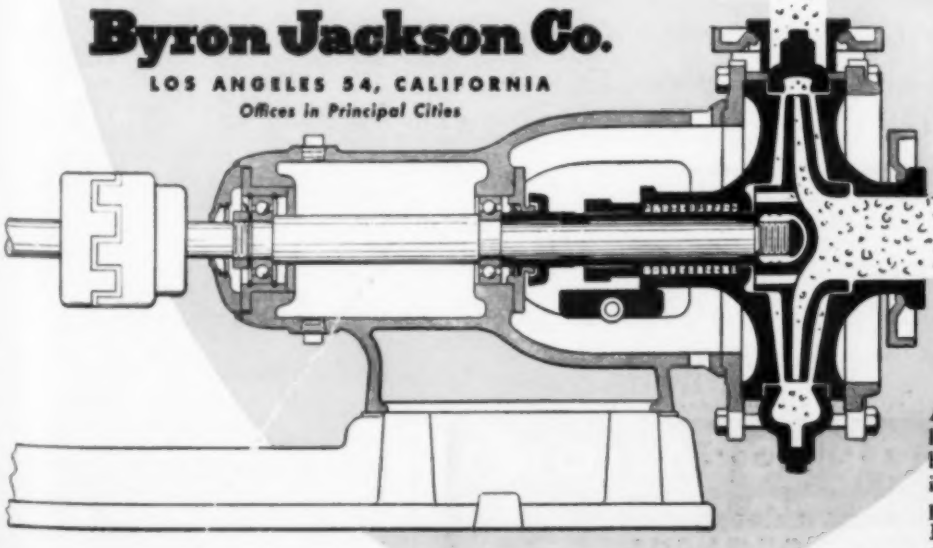

All pump parts that contact pumped liquid are of Corrosiron, as indicated by solid black cross-section areas in illustration. Sizes: 1½" to 3"; Capacities: 30 to 425 gpm; Pumping Heads: 20 to 140 feet; Speeds: 1150, 1450, and 1750 rpm.

1945-46. By O. C. Blade and C. R. Sponsler. Bureau of Mines, Report of Investigations R. I. 3959. Mimeographed.

Geophysical Abstracts 123, October-December, 1945, with an Index to Abstracts 120-123. By V. Skitsky. Bureau of Mines, Information Circular I. C. 7355. Mimeographed.

Extraction and Uses of Beryllium in Germany. By George T. Motock. Bureau of Mines, Information Circular I. C. 7357. Mimeographed.

Report of Petroleum and Natural Gas Division, Fiscal Year 1944. By R. A. Cattell, et al. Bureau of Mines, Information Circular I. C. 7358. Mimeographed.

Coal-Mine Explosions and Coal- and Metal-Mine Fires in the United States During the Fiscal Year Ended June 30, 1945. By D. Harrington, W. J. Fene, and H. B. Humphrey. Bureau of Mines, Information Circular I. C. 7359. Mimeographed.

Cement in Latin America. By Oliver Bowles and A. Taeves. Bureau of Mines, Information Circular I. C. 7360. Mimeographed.

Extraction and Uses of Lithium in Germany. By George T. Motock. Bureau of Mines, Information Circular I. C. 7361. Mimeographed.

Manufacture and Regeneration of Catalysts at I. G. Farbenindustrie Ludwigshafen/Oppau. By W. F. Faragher and W. A. Horne. Bureau of Mines, Information Circular I. C. 7368. Mimeographed.

Code of Federal Regulations 1944 Supplement. The Federal Register. Price $3. Clothbound.

Use of Insect Repellents and Miticides. By B. V. Travis and F. A. Norton. Bureau of Entomology and Plant Quarantine E-698. Mimeographed.

Geology and Paleontology of Palos Verdes Hills, California. By W. P. Woodring, et al. Geological Survey Professional Paper 207. Price $1.50.

Development of Joint Strength in Birch Plywood Glued with Phenol-, Resorcinol-, and Melamine-Resin Glues Cured at Several Temperatures. By H. D. Bruce, et al. Forest Products Laboratory, Madison, Wis. No. 1531. Mimeographed.

List of Publications on Pulp and Paper. Forest products Laboratory, Madison, Wis. No. R444. Mimeographed.

List of Publications on Wood Preservation. Forest Products Laboratory, Madison, Wis. No. R704. Mimeographed.

Possibilities of Increasing the Use of Hardwoods to Meet Pulpwood Requirements. By J. N. McGovern. Forest Products Laboratory, Madison, Wis. No. R1614. Mimeographed.

The Madison Wood-Sugar Process. By Elwin E. Harris and Edward Beglinger. Forest Products Laboratory, Madison, Wis. No. R1617. Mimeographed.

Fermentation of Douglas-Fir Hydrolyzate by S. Cerevisiae. By E. E. Harris, et al. Forest Products Laboratory, Madison, Wis. No. R1618. Mimeographed.

Mineral Statistics. The Bureau of Mines has begun issuing the separate preprint chapters of Minerals Yearbook 1945. Those wanting the latest printed data should ask the bureau for it, indicating the specific commodities in which they are interested. No general mailing lists are maintained.

Army-Navy Specifications. Office of Technical Services, Department of Commerce, is now furnishing photostats and microfilms of Army-Navy specifications for various products for which printed specifications are not otherwise available for distribution. Prices vary with the length of the specification. A list of specifications first made available is published in the "Bibliography of Scientific and Industrial Reports," issue of May 31, 1946, p. 1,280 ff. Those desiring other specifications should inquire as to availability of Library and Reports Division, Office of Technical Services, Washington 25, D. C.

Federal Specifications. New or revised specifications which make up Federal Standard Stock Catalog have been issued on the following items: Hydraulic Cements; General Specifications (Methods for Sampling, Inspection and Testing) SS-C-158b. Insulation; Mineral-Wool, Block and Board (For Heated Surfaces) HH-I-564. Jointing Compounds; Sulfur (For Bell-and-Spigot Cast-Iron Pipe) SS-C-608.

MANUFACTURERS' LATEST PUBLICATION

Chemical Engineering's Readers' Service, in cooperation with manufacturers, makes it possible for you to secure catalogs, bulletins, and other publications herein listed without cost or obligation (unless a price is specifically mentioned). Please check the items you wish to receive and fill out the coupon. Please send requests to Readers' Service, Chemical Engineering, 330 W. 42nd St., New York 18, N. Y.

1

Alloys. Alloy Metal Wire Co., Inc., Prospect Park, Pa.—Catalog D-2. 26-page catalog illustrating and describing the wire, strip, and rod of various alloys for high-temperature or corrosin-resisting applications. Includes engineering information on strength, electrical resistivity, modulus of elasticity, heat treatment, temperature limits and mangetic properties of various high nickel content alloys.

2

Alloys. Ampco Metal, Inc., Milwaukee, Wis.—Bulletin 64B.—16-page booklet gives information on the various types of Ampco metal and Ampcoloy bronzes available from this company. These extruded products include various rods and shapes. Also data sheet describing Ampco bearings used in heavy-duty machinery.

3

Bearings. New Departure Division, General Motors Corp., Bristol, Conn.—A series of three booklets on ball bearings for designers and engineers. Parts I and II deal with the principles, bearing types and fundamentals of mounting practice, and describe details of shaft and housing designs. Part III covers inclosure and lubrication for various operating conditions.

4

Blowers. General Blower Co., Morton Grove, Ill.—Booklet illustrates and describes this company's line of exhausters, fans, blowers and insulation blowing machines manufactured by this company. They are used for blowing, heating, cooling, conveying, aerating, separating and agitating operations.

5

Boiler Tubes. Jos. T. Ryerson & Son, Inc., Chicago, Ill.—8-page illustrated booklet featuring the Babcock & Wilcox electric resistance welded boiler tubes now distributed by this company.

6

Chemicals. Ansul Chemical Co., Marionette, Wis.—8-page reprint entitled "Liquid Methyl Chloride." Contains information on physical and chemical properties methods of transportation, storage, handling of containers, and other pertinent data. A second 12-page reprint entitled "Liquid Sulphur Dioxide." Contains information on the manufacture, handling and use of this chemical.

7

Chemicals. Hercules Powder Co., Wilmington, Del.—4-page leaflet featuring the use of Hercules chemicals in the pulp and paper industry.

8

Chemicals. Reilly Tar & Chemical Corp., Indianapolis, Ind.—44-page pocket-sized booklet listing and describing the coal tar products made by this company. Also a 6-page folder featuring the aluminum coating for metal surfaces made by this company.

9

Chemicals. Sharples Chemicals, Inc., Philadelphia, Pa.—72-page booklet describing the synthetic organic chemicals manufactured by this company. This booklet lists the commercial products and some products now in semi-commercial or laboratory stage of development. Contains information on over 150 synthetic organic chemicals, including alcohols, alkyl chlorides, substituted amides, amines, dithiocarbamic acid derivatives, ethers, esters, hydrocarbons, mercaptans, organic sulphides, phenols and others.

10

Cleaning Compounds. Phillips Chemicals Co., Chicago, Ill.—Handbook entitled "Production and Maintenance Cleaning," which gives information on proper methods and components for use in various types of production line as well as maintenance cleaning.

11

Compressors. Clark Bros. Co., Inc., Olean, N. Y.—4-page leaflet featuring the use of Clark steam-driven compressors in the manufacture of synthetic ammonia.

12

Compressors. Watson-Stillman Co., Roselle, N. J.—Bulletin 370-C.—8-page booklet featuring the general purpose hydraulic compressors in capacities of 20 to 200 tons. Includes photographs of equipment together with a table of specifications.

13

Construction. Brown & Root, Inc., Houston,

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CLEANING AND CORROSION TIPS

Issue No. 5

SEPTEMBER 1946

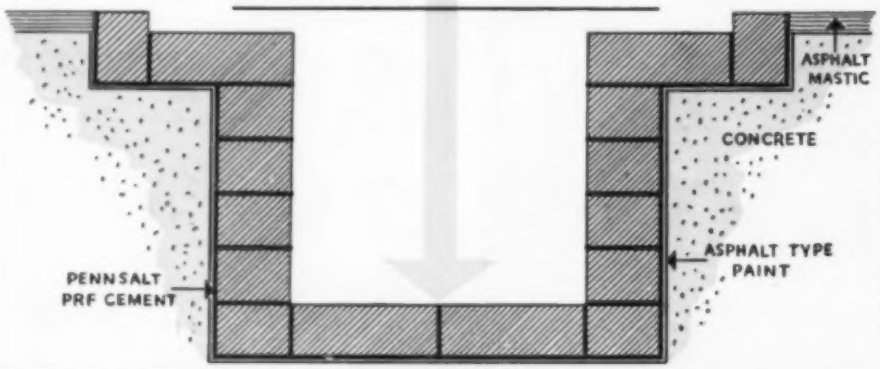
CASE NO. 938

Acid-alkali drains as good as new after 6 years . . . Require no repairs or maintenance

Six years ago, a large nationally-known manufacturing plant installed an acid and alkali resisting floor in its plating room, with draining troughs between the plating tanks to carry off splashes and spent contents.

These troughs—constructed of acid-proof brick laid in Pennsalt PRF Cement mortar—handle the following chemicals in various concentrations:

Sulfuric Acid at 180°-200° F.	Nitric Acid—both hot and cold
Caustic Soda—hot	Copper Cyanide
Iron Chloride	Chromic Acid
Nickel Cyanide	Water



After six years, this construction is as serviceable as the day it was put into operation; no maintenance or repairs have been required. As a matter of fact, some of the original trowel marks are still visible on the mortar joints . . . clear proof of the efficiency of the Pennsalt PRF Cement. Pennsalt PRF is a resin-type cement specifically designed for bonding acid-proof bricks in construction where resistance to many acids, alkalis and solvents is desired.

The sketch at left illustrates the details of construction of the troughs. The plating room floor was covered with a mastic—98% pure asphalt. The concrete surface of the troughs was given two coats of asphalt-type paint, then lined with acid-proof brick buttered with Pennsalt PRF Cement mortar which when hard is unaffected by most acids, alkalis and solvents.

CASE NO. 911

Pennsalt Cleaner eliminates rejects

An electroplating company had been getting poor results in removing compound from polished brass prior to bright nickel plating. The superintendent had tried various cleaning processes with no improvement in finished work.

When the Pennsalt Man stopped by, he was handed the problem. After studying it carefully he added a pre-cleaning dip in Pennsalt EC-10*, and replaced the old cleaner with a Pennsalt product in the regular cycle. Results: another point for Pennsalt technical know-how and superior products. The work came through with brilliant lustre, and all rejects due to cleaning were eliminated.

*TRADE MARK—REG. U. S. PAT. OFF.

CASE NO. 935

Work 100% better . . . cleaning time cut in half . . . less material needed

A concern was only getting fair results in cleaning 1020 deep-drawn steel parts prior to pickling and painting. The soil in question was mineral oil and sulfur drawing lubricant.

Believing that he could improve the situation, the Pennsalt Man replaced the old cleaner with a Pennsalt product, and the work was run through the new cycle. The foreman pronounced the work "100% better"; cleaning time was cut nearly in half, and less cleaning material was needed.

This is just an example of the opportunities that come to the cleaning foreman who is constantly looking for better ways of doing things. It's also a typical example of the kind of results being achieved throughout industry by the knowledge and training of the Pennsalt Men, backed by the high-quality products in the Pennsalt line.

CASE NO. 929

Management thinks a lot of this cleaning superintendent . . . and here's why

Small parts of 1050 spring steel were being descaled and de-smutted by a mechanical grit blast, prior to cadmium plating. The grit blasting was doing a fair enough job of cleaning the work, but the superintendent realized that a better finish would improve the plating job, and he was determined to find a better descaling method.

He put the problem up to the Pennsalt Man who worked out a chemical cleaning process that would do the job. The new cycle—culminating a series of trials and errors—greatly improved the lustre of the finished work, and made possible a better plating job. Furthermore, the Pennsalt method cut descaling and de-smutting time to one-quarter of the time formerly needed, and cut cleaning costs in half.

Chemical descaling proved itself completely to the cleaning superintendent, and he presented the results to the management. The boss was so pleased that he is considering the purchase of additional equipment in order to standardize on the Pennsalt Descaling Process in his plant.

If you have a metal cleaning or corrosion problem, the Pennsalt Man can help you. If you would like to see him, write to Dept. CM-9. Or—if your problem is urgent—wire, and he will call immediately.

Tex.—Illustrated brochure describing the services offered by this company.

14

Dust Collector. American Air Filter Co., Inc., Louisville, Ky.—Bulletin 253.—16-page illustrated booklet describing the Electro-Air-mat Model A electronic precipitator manufactured by this company. The principle of operation of this dry type precipitator is explained and illustrated with diagrammatic sketches. Includes data on installation, maintenance, efficiency and voltage requirements.

15

Dust Collector. American Foundry Equipment Co., Mishawaka, Ind.—8-page booklet featuring the dust control equipment available from this company.

16

Electric Equipment. Allis-Chalmers Mfg. Co., Milwaukee, Wis.—Bulletin C 6452.—16-page letter size handbook of electrical equipment used by a wide variety of industries. Describes classifications of electrical equipment ranging from a.c. and d.c. motors to electronic heaters. Also Booklet 25 D 6177 B containing 16 pages entitled "Buying Guide of Allis-Chalmers Equipment for the Process Industries."

17

Electric Equipment. Cannon Electric Development Co., Los Angeles, Calif.—Bulletin No. W. 146. 2-page booklet describing and illustrating the Type W waterproof connectors made by this company. Details are illustrated in diagrammatic sketches and tables of dimensions for the various models are given.

18

Electric Equipment. Delta-Star Electric Co., Chicago, Ill.—Publication 4607. This bulletin describes and lists this company's line of single conductor cable terminators or potheads.

19

Electric Equipment. Clarostat Mfg. Co., Inc., Brooklyn, N. Y.—Bulletin 100. A bound volume of eighteen different bulletins illustrating and describing various electric equipment such as potentiometers, rheostats, resistors, etc., made by this company.

20

Electric Equipment. Meletron Corp., Los Angeles, Calif.—2-page leaflet illustrating and describing the explosion-proof pressure-operated switch for hazardous locations, manufactured by this company. Models 320 and 330.

21

Electric Motors. Century Electric Co., St. Louis, Ill.—Form 643. 8-page illustrated booklet featuring the slip ring induction polyphase motors from 1 to 350 hp., available from this company. Contains information on operating characteristics, and suggested applications.

22

Electronic Heating. Radio Receptor Co., Inc., New York, N. Y.—Bulletin 7005. 8-page booklet entitled "Electronic Heating and Sealing With the Thermatron" illustrates and describes the use of electronic generators for the preheating and sealing of plastics, rubber, plywood and various other dielectric materials.

23

Equipment. American Car & Foundry Co., New York, N. Y.—94-page book describing the contributions made to war-time production.

24

Filters. Drico Industrial Corp., New York, N. Y.—46-page booklet giving information on the use of filters in the purification of air, gas and liquids. It gives a good deal of general information on filtration, as well as giving data on the equipment manufactured by this company.

25

Fire Prevention. The National Board of Fire Underwriters, New York, N. Y.—44-page booklet entitled "Fires That Never Happen." Contains information on organized fire prevention work during the war.

26

Flexible Couplings. John Waldron Corp., New Brunswick, N. J.—Catalog No. 57. 20-page booklet illustrating and describing the Series A flexible couplings available from this company. Various standard and special types of couplings are illustrated, includes dimensional sketches and rating tables for each type of coupling.

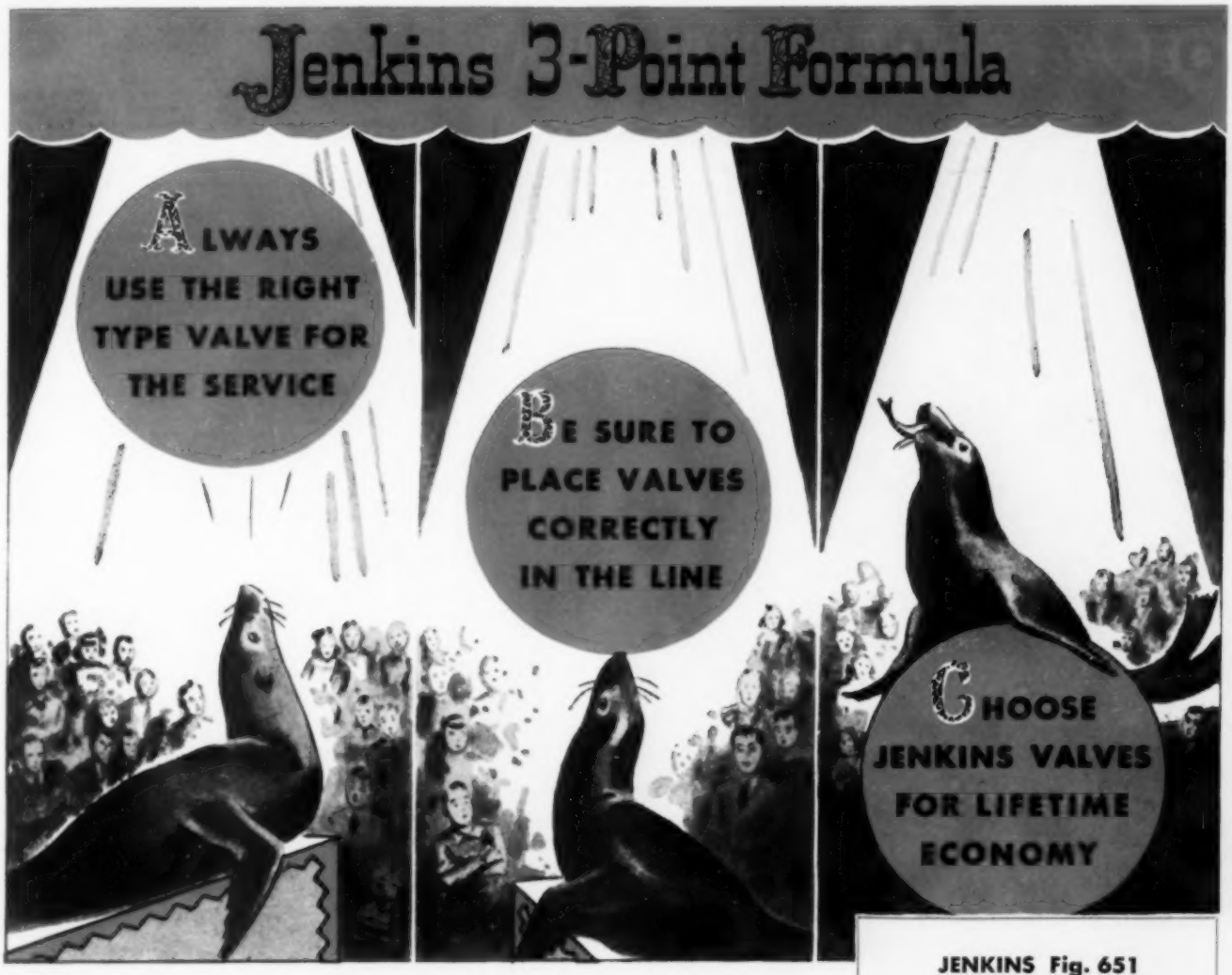
27

Floor Coating. Truscon Laboratories, Inc., Detroit, Mich.—Book B. New specification book describes the floor treating compounds made by this company. It covers such subjects as wood floor preservatives, surface coatings with a wood rubber base, concrete dyes and other materials for covering floors.

28

Flooring. Walter Maguire Co., Inc., New

Jenkins 3-Point Formula



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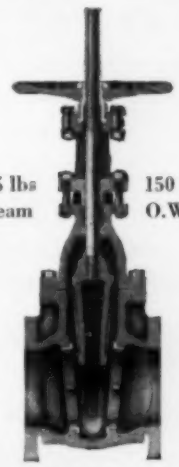
Sold through Reliable Industrial Distributors Everywhere.

JENKINS Fig. 651
Removable Seat Ring
IRON BODY GATE VALVE



125 lbs Steam — 150 lbs. O.W.G.

On this outside screw and yoke valve (flanged) the spindle rises up through the yoke sleeve. All pressure-containing parts are "semi-steel" for extra strength. The cast bronze seat ring is removable. Easily removed. Rolled rod bronze spindle available. Valve can be repacked under full pressure.

ONE OF OVER 600 EXTRA VALUE VALVES MADE BY JENKINS *VALVE SPECIALISTS*

York, N. Y.—Bulletin No. 602. New book that illustrates and describes the Emeri-Crete flooring made with emery aggregates.

29

Gaskets. United States Gasket Co., Camden, N. J.—Catalog No. 303. 30-page catalog illustrating and describing the complete line of gaskets made by this company. Includes engineering reference tables which show data on size, shapes and temperature conversions, together with other pertinent gasket information.

30

Heat Exchangers. Tenney Engineering, Inc., Newark, N. J.—Catalog CD-46. 20-page catalog illustrating and describing the cooling unit made by this company. Includes prices, coil selection tables, formulas for determining coil sizes, and other engineering data. Also contains a product storage load data section for various commodities usually placed in cold storage.

31

Heat Treating. Surface Combustion Corp., Toledo, Ohio.—Bulletin SC-131. 4-page illustrated booklet describing furnaces for hardening metals. Includes information on ovens, pots and acid hardening furnaces, as well as isothermal quench furnaces.

32

Industrial Clothing. Archer Rubber Co., Milford, Mass.—8- page catalog of waterproof work clothing for industrial workers.

33

Instruments. Automatic Temperature Control Co., Inc., Philadelphia 44, Pa.—4-page leaflet illustrating and describing the special-built time switches made by this company. This bulletin describes some examples of special-built time switches for the volume user. This is a new service rendered by this company who formerly supplied just standard line instruments and control systems.

34

Instruments. Bailey Meter Co., Cleveland, Ohio—Bulletin 17. 8-page bulletin illustrating and describing this company's instruments and controls for the process industries. Contains information on controllers, control components, difficult control systems, multi-element systems, measuring components, and instrument combinations. It is well illustrated with diagrams.

35

Instruments. The Bristol Co., Waterbury, Conn.—Bulletin No. 1400. 12-page bulletin describes this company's line of tachometer recorders and indicators. Includes wiring diagrams, application data and information on accessories.

36

Instruments. Leslie Co., Lyndhurst, N. J.—A new 35-mm. sound slide film showing methods of handling pressure and temperature control problems is available from this company. Having a running time of about twenty minutes, this film follows the steam system of a typical industrial plant from the high-pressure steam at the boiler through the power generating equipment, processing machinery, boiler auxiliaries, heating and low-pressure systems. Arrangements for showing this slide film can be made direct through this company.

37

Instruments. Palmer Thermometers, Inc., Cincinnati, Ohio.—Two leaflets featuring the thermometers with full reading scales available from this company. The thermometers have a double strength brass shield to protect the thermometer tube and to keep the thermometer clean.

38

Instruments. Photoswitch, Inc., Cambridge, Mass.—2-page leaflet illustrates and describes the Series 20 and 21 photo-electric controls manufactured by this company. Includes specifications and installation sketches.

39

Instruments. Taber Instrument Corp., North Tonawanda, N. Y.—6-page bulletin illustrating and describing the Thermofold plastic folding machine made by this company. Principles of operation and outstanding features are described and illustrated with photographs. The method of operation is described in detail.

40

Instruments. Wheelco Instrument Co., Chicago, Ill.—Bulletin D-602-4. 4-page booklet illustrating and describing the portable pyrometers manufactured by this company. Includes data and specifications on the various accessories required for use.

41

Instruments. G. C. Wilson & Co., Chatham, N. J.—Two leaflets describing electronic servo-

New Life For Dead Ends

Put some fresh air in those confined working areas—and you'll put new life into the men who are working there.

At 110°F. a man's working efficiency is only about 10%. In foul air, his efficiency is equally low, and there's a chance he'll become ill. Fresh, cool air costs so little, it's a shame to lose so much working efficiency for lack of it.

You'll find a Coppus Blower designed for almost any type of dead end you may have — for underground cable manholes, furnaces, tanks, tank cars, etc., or around hot jobs like coke ovens or steam processes. They are also handy for cooling and drying equipment or materials in process.

Each one is portable . . . designed for the convenience of the workers and maximum use of air . . . built to Coppus "Blue Ribbon" specifications regarding materials and construction so as to take plenty of rough service.

For specific information, check and mail the coupon. Address Coppus Engineering Corp., 459 Park Avenue, Worcester 2, Mass. Sales Offices in THOMAS' REGISTER. Other "Blue Ribbon" Products in SWEET'S CATALOG, CHEMICAL ENGINEERING CATALOG and REFINERY CATALOG.

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COPPUS
"BLUE RIBBON" PRODUCT

COPPUS ENGINEERING CORP., 459 PARK AVENUE, WORCESTER 2, MASS.
Please send me information on the Blowers that clear the air for action.

- ☐ in tanks, tank cars, drums, etc.
- ☐ in underground cable manholes.
- ☐ in aeroplane fusilages, wings, etc.
- ☐ on coke ovens.
- ☐ on steam-heated rubber processes.
- ☐ on boiler repair jobs.

COOLING:

- ☐ motors, generators, switchboards.
- ☐ wires and sheets.
- ☐ general man cooling.
- ☐ around cracking stills.
- ☐ exhausters, welding fumes
- ☐ stirring up stagnant air wherever men are working or material is drying.

NAME .....
COMPANY .....
ADDRESS .....
CITY .....

(Write here any special ventilating problem you may have).

mechanism and the use of supersonics in certain processes.

42

Lubricant Testing. Mellon Institute of Industrial Research, Pittsburgh, Pa.—12-page reprint entitled "The Comprehensive Laboratory Testing of Instrument Lubricants."

43

Materials Handling. Automatic Transportation Co., Chicago, Ill.—The "Blue Book of Transporter Users" lists the outstanding companies in various industries using the transporter motorized hand truck made by this company.

44

Materials Handling. Crescent Truck Co., Lebanon, Pa.—4-page illustrated leaflet describing the Palletier fork truck made by this company. Diagrams give dimensions of the different models. Specifications are included.

45

Materials Handling. The Rapids-Standard Co., Inc., Grand Rapids, Mich.—Bulletin TR-NSP-4 is a 4-page leaflet describing the heavy-duty Warehouser and the ordinary duty Handy Andy floor trucks made by this company.

46

Materials Handling. Reading Chain & Block Corp., Reading, Pa.—Catalog No. 60. 36-page illustrated booklet giving information on the selection of chain hoists for different types of applications. Includes data on capacities, lifting speeds, applications and operating efficiencies of the various types of hoists made by this company.

47

Materials Handling. Vulcan Iron Works, Wilkes-Barre, Pa.—Bulletin A-407. 32-page booklet illustrating and describing the self-contained electric hoist made by this company. Includes a section on various safety devices incorporated in these hoists.

48

Milling Equipment. Farrel-Birmingham Co., Ansonia, Conn.—Bulletin 21-R-462. 4-page bulletin featuring the new small-sized Banbury mixer and other milling equipment.

49

Pipe Fitting Tools. T. G. Persson Co., Bloomfield, N. J.—Two single-page leaflets featuring the flange-jack made by this company. They are used for opening flanges in pipelines.

50

Piping. The Duriron Co., Inc., Dayton, Ohio. Bulletin 704. 4-page leaflet containing information on Duriron and Durichlor acid-resisting flanged pipe and fittings. Sizes and dimensions of the pipe and various fittings are tabulated and a section of the bulletin is devoted to installation methods.

51

Power Generators. Kato Engineering Co., Mankato, Minn.—10-page illustrated booklet describing the Katolight generators.

52

Power Transmission. D. O. James Manufacturing Co., Chicago, Ill.—Catalog 1000. 575-page catalog giving practical engineering information on power transmission equipment. Includes sections on dimensions, rating tables and general information on design and application of various types of cut gears, gear speed reducing transmissions, and flexible couplings. The 100-page engineering section contains tables, charts and formulas useful in solving gear design problems.

53

Pumps. Economy Pumps, Inc., Hamilton, Ohio.—Bulletin D-246. 8-page bulletin illustrates and describes the Type SCV pump made by this company. Construction features are shown, together with tables of dimensions. Outstanding features are illustrated.

54

Pumps. Warren Steam Pump Co., Inc., Warren, Mass.—6-page illustrated folder describing the single-stage, double-suction type DBL centrifugal pump made by this company. Cutaway view shows construction details. Includes rating tables, dimensions, and other information.

Requests for literature listed below should be sent direct to company address. Not available from Reader's Service.

Aluminum and Aluminum Alloys. Reynolds Metals Co., Dept. 47, 2500 South Third St., Louisville 1, Ky.—88-page book illustrating and describing gas welding, arc welding, resistance welding, brazing and soldering aluminum and aluminum alloys. Price $1. Also an 8½ x 11-in. slide rule type of selector chart for correlating the technical information on 18 of the most widely used aluminum alloys. Price $1.

CHEMICAL ECONOMICS

H. M. BATTERS, Market Editor

PRODUCTION AND CONSUMPTION OF CHEMICALS MOVE UPWARD WITH DEMAND SURPASSING SUPPLY

PRODUCTION of chemicals has made moderate gains in recent weeks with some improvement in the supply situation but shortages still are in evidence and it is generally conceded that many chemicals will be scarce over the remainder of this year and possibly over next year as well. Latest available data on the volume of chemical output cover the month of July and the index of the Federal Reserve Board places industrial chemical production for that month at 389. The index for June was dropped from the preliminary figure of 399 to the same level as reported for July but production figures show larger outputs in July for such important chemicals as sulphuric and nitric acids, ammonia and ammonium compounds, chlorine, caustic soda, soda ash, phosphates, and bichromates. In July 1945 the index stood at 409, or close to the wartime peak, but it dropped in August to 386 so that current activities at chemical plants are higher than they were a year ago.

Consumption of chemicals dropped in June but turned upward in July and, based on unofficial data, operations in August continued on a rising line. The index of *Chemical Engineering* places industrial consumption of chemicals at 201.58 in July compared with a revised figure of 192.71 for June. Most of the important consuming industries contributed to the advance made in July but pulp and paper mills were a notable exception as pulp production fell from 841,674 tons in June to 788,284 tons in July and paper output—excluding building paper, newsprint, and paperboard—dropped from 671,349 tons to 631,789 tons in the same interval.

Because of the almost universal use of chemicals throughout industry, demand increases as general industry expands. The Federal Reserve Board index for all production moved up to 175 in July with 171 as the June figure. This establishes July as the most active month in industry since the end of the war but still considerably below the level of July 1945 which was reported at 211. The rise in building and in automotive production has encouraged larger outputs of flat glass and with soda ash more plentiful, glass container plants in July turned out 9,604 thousand gross of containers, a monthly total exceeded only three times in the history of the industry.

Steel mills made the best showing of the year in August with a corresponding rise in their requirements for chemicals. Oil refiners also made their best showing in August. In the plastics field a mixed situation exists. Some types have been cut back because of shortages in raw materials while others have made progress because some of the materials they require have been available in larger volume. Over-all production of plastics in September promises to be affected by labor troubles as one important producing plant is currently strike-bound. Paint makers are looking for an improved situation in drying oils but the outlook for an ample supply of basic pigments is none too bright.

The report of sharp increases in inventories apparently has little application to the chemical industry as the Department of Commerce in reporting on chemicals in August stressed the shortages which exist in many branches of the industry. The report said that plastic molding powder and compounds and synthetic resins are in very light supply with government administered priority assistance barely channeling enough supplies to prevent the closing of some plants. On coal-tars the report said output of crudes improved this spring as coke oven operations approached full capacity. However supply still is insufficient to satisfy demand. Cyclic intermediates also were produced in larger volume but inventories are not yet large enough to permit satisfactory distribution to consumers nor are dye manufacturers able to fill the orders which have come to them.

Referring to insecticides, the report is more favorable, stating that the outlook for insecticides and fungicides is brighter than in the past with heavy imports of white arsenic this spring contributing toward easing the shortage. Available supplies of calcium arsenate, about two-thirds of normal, and of nicotine are too small to meet effectively large-scale attacks by boll weevils and aphids. Only paris green is in plentiful supply.

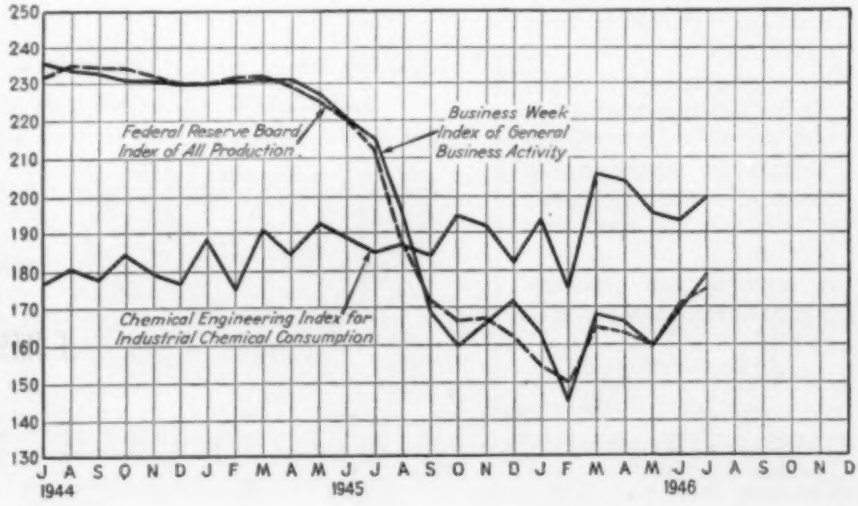
Price decontrol in some branches of the chemical industry is making progress, the latest being a suspension of control over gum and wood rosin of all grades. This decision was based on a study which showed that the rate of production, stocks, availability of materials, labor and facilities as well as present and future needs indicated that the rosin supply is in approximate balance with demand.

The extent to which alcohol production has fallen off is shown by the data released by the Bureau of Internal Revenue, for the fiscal year ended June 30. For 1945-46, the output of ethyl alcohol was 353,677,148 proof gal. Production of completely denatured was 26,144,378 wine gal. and specially denatured, 186,665,097 wine gal. Stocks on June 30, 1946 were: 110,538,985 proof gal. of ethyl alcohol; 45,597 wine gal. completely denatured; 8,916,369 wine gal. specially denatured. For 1944-45, production was 683,431,544 proof gal. ethyl

***Chemical Engineering* Index**
Industrial Consumption of Chemicals

1935 = 100

	June Revised	July
Fertilizers	38.94	42.40
Pulp and paper	21.36	19.98
Petroleum refining	18.90	19.60
Glass	19.97	22.08
Paint and varnish	21.45	21.16
Iron and steel	10.14	12.57
Rayon	18.68	19.76
Textiles	10.82	10.19
Coal products	8.06	9.67
Leather	4.65	4.60
Industrial explosives	6.90	6.17
Rubber	6.90	7.10
Plastics	5.94	6.30
	192.71	201.58



alcohol; 33,087,533 wine gal. completely denatured; 494,008,004 wine gal. specially denatured. Stocks on June 30, 1945 were 141,198,239 proof gal. ethyl alcohol, 1,013,268 wine gal. completely denatured, and 20,623,245 wine gal. specially denatured.

With regard to the recent announcement that the International Emergency Food Council had allotted 202 million gallons of molasses for United States consumption in 1946, this is an increase of only 10 million over the previous figure and comes from agreement with foreign countries to reduce their unshipped allotments. Attempts are being made to bolster home supply by obtaining permission for further cuts in exports. All but about 8 to 10 million gallons assigned for U. S. consumption from the 115 million gallons covered in the agreement signed with Cuba last July, already has been delivered. All but one of the previously idle fermentation plants are now operating at around 35 percent of capacity.

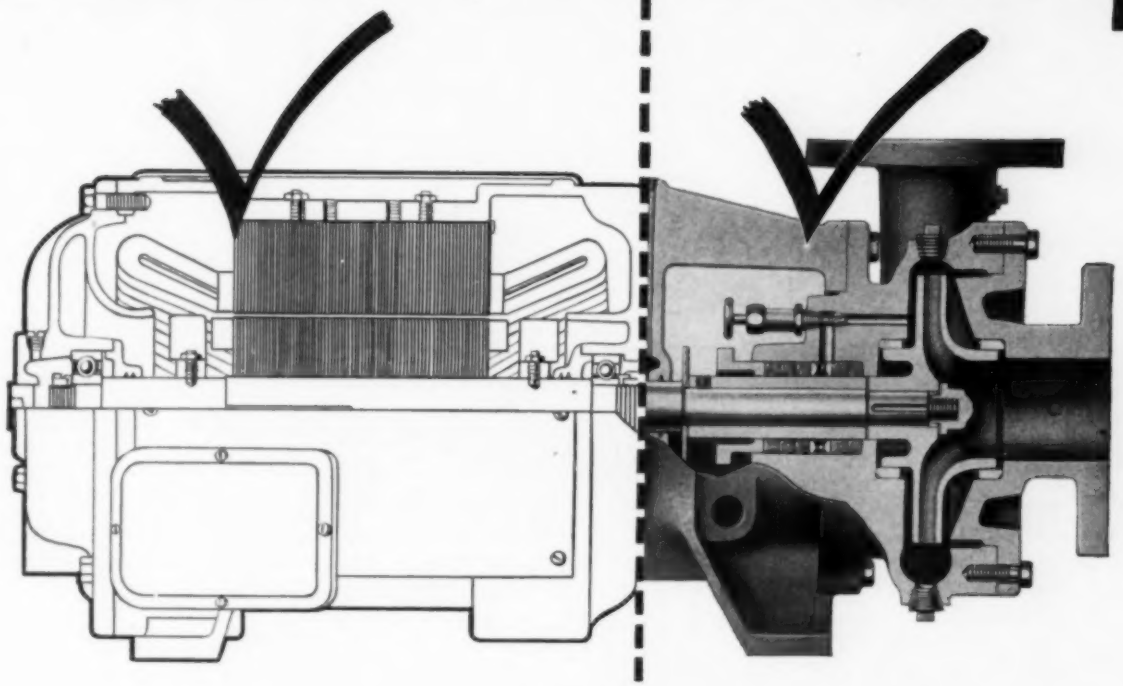
Estimated breakdown of the 115 million gallons of molasses allotted the U. S. for 1946 are: for feedstuffs, 70 million; for ethyl alcohol, 55 million; for butyl alcohol, 30 million; for yeast, 30 mollion; for citric acid, 6 million; for rum, 4 million; for insecticides and miscellaneous uses, 2 million.

The Naval Stores Research Division of the Bureau of Agricultural and Industrial Chemistry reports an increase in production of rosin and turpentine for the first quarter of the current crop year as compared with the corresponding period a year ago. Consumption also was higher this year and the same was true for export shipments, especially in the case of rosin. Total movement for the quarter exceeded production and stocks at the end of June were below those reported for March 31.

Supply and Distribution of Turpentine and Rosin

	April–June, 1946			April–June, 1945		
Turpentine, 50-Gal. Bbl.	Total	Gum	Wood	Total	Gum	Wood
Carryover, April 1	100,749	58,088	42,661	202,546	168,011	34,535
Production	145,477	78,677	66,800	139,046	74,574	64,472
Imports	6,149	6,149	.....	4,875	4,875	.....
Available supply	252,375	142,914	109,461	346,467	247,460	99,007
Carryover, June 30	77,440	39,002	38,438	184,777	148,899	35,878
Apparent consumption	174,935	103,912	71,023	161,690	98,561	63,129
Exports	22,798	16,451	6,347	19,697	15,305	4,392
Apparent U. S. consumption	152,137	87,461	64,676	141,993	83,256	58,737
Rosin, 520-Lb. Drums						
Carryover, April 1	388,682	237,504	151,178	388,266	265,881	122,385
Production	416,193	206,496	210,194	376,750	201,392	175,358
Imports	.....	.....	.....	5,313	5,313	.....
Available supply	805,372	444,000	361,372	770,329	472,586	297,743
Carryover, June 30	364,179	239,887	124,292	383,979	250,958	133,021
Apparent consumption	441,193	204,113	237,080	386,350	221,628	164,722
Exports	91,423	63,481	27,942	33,774	15,182	18,592
Apparent U. S. consumption	349,770	140,632	209,138	352,576	206,446	146,130

Motor *and* Pump



...combined

TO GIVE UNDIVIDED RESPONSIBILITY FOR CAPACITY... EFFICIENCY... HEAD

NOT ONE maker's pump hooked up to another maker's motor —but pump AND motor, designed and built as a unit by Allis-Chalmers.

There's no buck-passing. Allis-Chalmers backs every "Electrifugal" pump all the way — tests and checks the performance of each unit, at the factory.

FOR EVERY PUMPING NEED . . . CALL ON A-C

This versatile, popular "Electrifugal" pump is only part of the complete Allis-Chalmers line of centrifugal, axial and mixed-flow pumps — single or double suction, single or multi-stage, capacities up to 170,000 gpm. Call your A-C office or dealer — or write for bulletin B6018. ALLIS-CHALMERS, MILWAUKEE.

A2073

SPLASH-PROOF, LO-MAINTENANCE MOTOR — specially built for pump service. Sturdy, long-life rotor, interchangeable stator coils.

PUMP AND MOTOR IN ONE RUGGED FRAME, and on the same shaft. Result: perfect alignment; smooth, vibrationless operation; longer bearing life.

EASY INSTALLATION AND MAINTENANCE. Just hook up and pump . . . operates in almost any position . . . all parts easily accessible for checking and service.

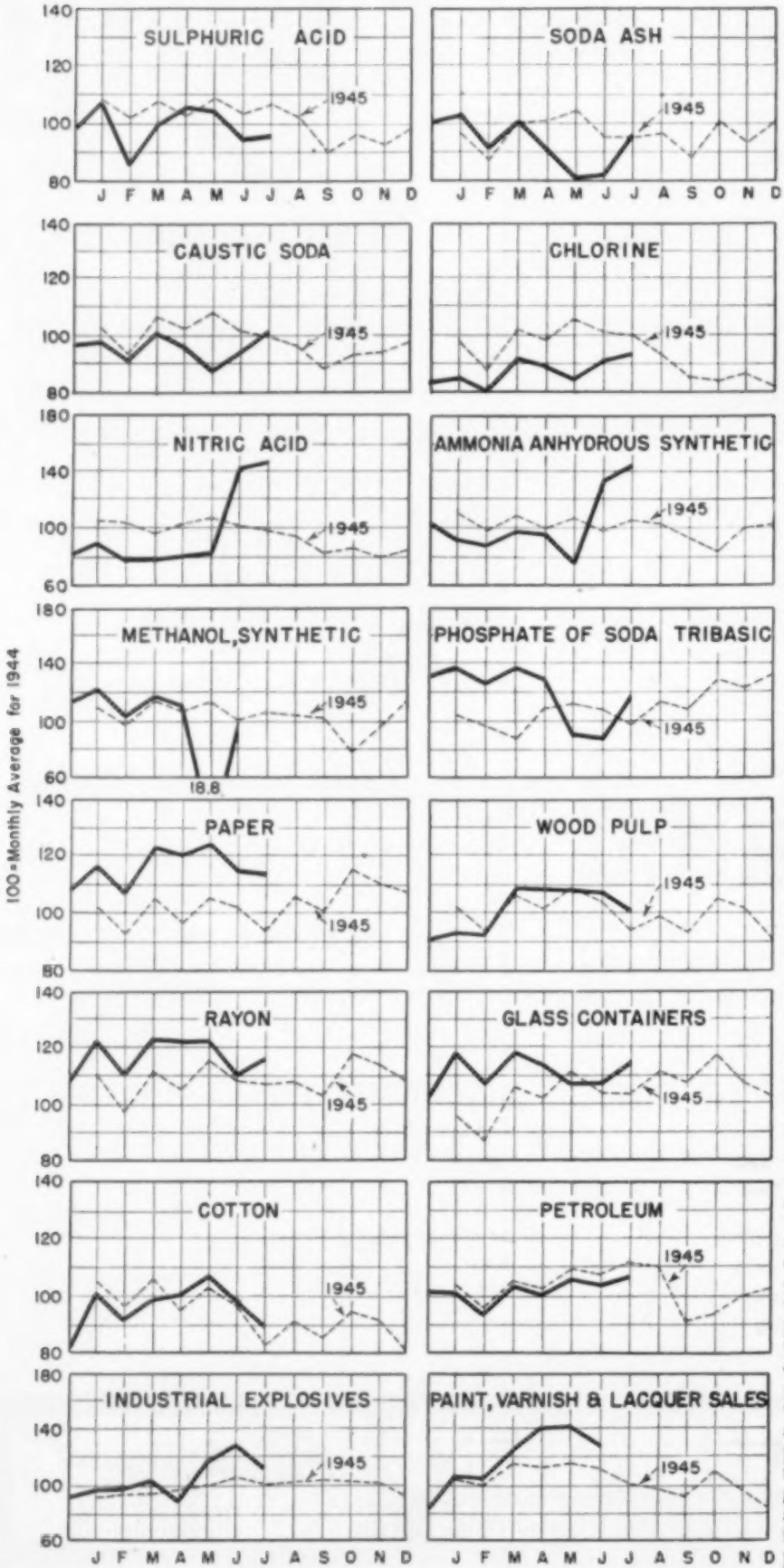
SIZES FROM ¾ TO 25 HP meeting a wide range of requirements as to capacity, head, and fluids to be pumped.

ALLIS-CHALMERS

★ One of the Big 3 in Electric Power Equipment
Biggest of All in Range of Industrial Products ★

Electrifugal PUMPS

PRODUCTION AND CONSUMPTION TRENDS



A RISE in output, a drop in shipments, and a sharp rise in the value of inventories, summarizes a report of the Department of Commerce on the status of industry in July. Wide publicity given to the piling up of large stocks at producing points had a disquieting effect as some interpretations regarded this as an indication that production had reached a level in excess of consuming requirements, the first evidence that the production peak had been reached. Actually the rise in production was encouraging. The drop in shipments, at least in part, was due to the fact that a considerable part of manufactured products were but semi-finished with one or more parts missing. This increase in partially completed goods also showed up in the inventory totals but it is probable that absence of price controls during the month was of even greater importance. A revaluation of goods held at plants, with current and not previous ceiling prices as the basis, would in itself account for a healthy rise in value even though there was no increase in physical volume.

With few exceptions, stocks of chemicals remain small with scarcities rather than stockpiles being reported. It has become more evident as the year advanced that some of the heavier tonnage chemicals would be scarce throughout the year. Consuming requirements are high and existing productive capacities are not sufficient to turn out the chemicals in volume sufficient to take care of home and foreign demands. For one reason or another, much of the proposed expansions in capacities have been slow to materialize and it is probable that many chemicals will be in limited supply for most of 1947.

A mixed trend has been noted in activities at vegetable oils plants. A total of 566,830 tons of oil-bearing material was processed in July as compared with 543,839 tons in June. Crushing of cottonseed will gain in volume as new crop seed becomes available.

Larger crushings of copra give a more encouraging outlook for glycerine but at present that material is scarce and it is estimated that domestic production this year plus imports will run under 200,000,000 lb. with the potential market considerably above that figure. The long drawn-out period through which the supply of glycerine has been inadequate, has given an impetus to the establishment of large-scale synthetic production and while no official announcements have been forthcoming, it has been reported that one of the large oil refining companies will build a plant in Texas which will produce synthetic glycerine at a rate about 20 percent of that estimated for 1945 domestic output. It is further reported that the plant will be ready for operation early in 1948 and that the decision to go ahead with the project was aided by the expressed willingness of large consumers to contract for a good part of the proposed output as well as by the belief that future requirements for glycerine will be far larger than the prewar normal.

END USES FOR CHEMICALS

THE Bureau of the Census has released further data showing wartime end uses of chemicals based on allocation records of the War Production Board. The data with the periods covered are:

Toluene

January 1, 1943–June 30, 1945

	1,000 Gal.	Percent
Total allocations	521,274	100.0
Direct military*	399,274	76.7
Foreign	9,572	1.8
Other uses	111,722	21.5
Aviation gasoline including military	90,425	17.4
Protective coatings, naturants solvents	11,781	2.3
Miscellaneous†	9,516	1.8

* End-use data not available. † Includes medicinal, chemical, and research uses; dyes, preservatives, and small lots.

Xylene

July 1, 1944–June 30, 1945

	1,000 Gal.	Percent
Total allocations	95,770	100.0
Direct military*	916	0.9
Foreign	59	0.1
Other uses	94,795	99.0
Aviation gasoline blends†	70,270	73.4
Protective coatings	18,717	19.6
Medicinals	1,184	1.2
Inks, dyes, intermediates	684	0.7
Adhesives and cements	670	0.7
Cleaning fluids	493	0.5
Miscellaneous	2,777	2.9

* End-use data not available. † Includes military aviation fuel.

Acetone

January 1, 1944–June 30, 1945

	1,000 Lb.	Percent
Total allocations	632,519	100.0
Direct military*	41,790	6.6
Foreign	50,945	8.1
Other uses	539,784	85.3
Chemical manufacture	263,270	41.6
Solvents†	89,933	14.2
Coated fabrics and rayon	70,996	11.2
Drugs and pharmaceuticals	37,565	6.0
Resins and plastics	31,095	4.9
Rubber manufacture	16,566	2.6
Photography	8,908	1.4
Miscellaneous	21,451	3.4

* End-use data not available. † Of this amount, 22,365,000 lb. was used as a solvent for acetylene.

Carbon Tetrachloride

July 1, 1944–June 30, 1945

	1,000 Lb. Pure	Percent
Total allocations	223,092	100.0
Direct military*	56,885	25.5
Foreign	2,422	1.1
Other uses	163,785	73.4
Fire extinguishers	94,291	42.3
Degreasing compounds	31,511	14.1
Dry cleaning	10,892	4.9
Agriculture	4,837	2.1
Drugs	3,549	1.6
Synthetic rubber	3,366	1.5
Miscellaneous	15,339	6.9

* End-use data not available.

Dimethyl Phthalate

January 1, 1944–December 31, 1944

	1,000 Lb.	Percent
Total allocations	30,045	100.0
Direct military*	64	0.2
Foreign	2,313	7.7
Other uses	27,668	92.1
Insect repellant	26,927	89.6
Plastics	595	2.0
Cable lacquer and penetrants	58	0.2
Miscellaneous†	88	0.3

* End-use data not available. † Includes small amounts allocated for lacquers, film, lubricants, adhesives, and resale.

REDUCING MATERIAL COST OF LARGE CORROSION-RESISTANT EQUIPMENT

Two plates of Lukens Monel-Clad Steel, 96" long, 72" wide, 1½" thick, were used to fabricate the tube sheets for this heat exchanger unit installed at the Richmond Refinery of Standard Oil Company of California.

Bayonet-type Monel tube bundle for an HF alkylation unit dehydration reboiler with Lukens Monel-Clad Steel tube sheets, built for Bechtel-McCone Corp., Los Angeles, Calif., by A. O. Smith Corp., Milwaukee, Wis.

Tube Sheets

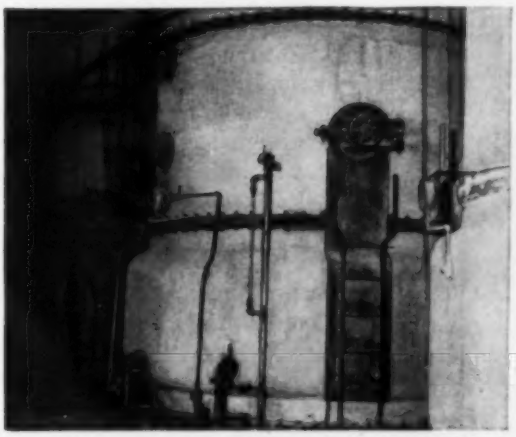
that prevent corrosion and distortion

IN the fabrication of tube sheets for this heat exchanger at Standard Oil Company of California's Richmond Refinery, Lukens Monel-Clad Steel was used. The Monel cladding prevents corrosion from the salt water cooling medium, while the steel base permits rerolling of condenser tubes without distortion of the tube sheets.

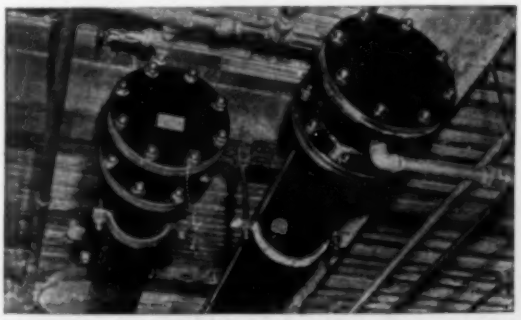
For equipment where the problem of corrosion must be solved economically without sacrificing structural strength, Lukens Clad Steels are recommended. Tube sheets, reboiler shells, pipes and similar parts are among such applications.

Lukens Clad Steels — Nickel-Clad, Inconel-Clad, Monel-Clad — consist of a layer of the corrosion-resistant metal permanently bonded to a backing plate of steel. Bulletin 255, "Lukens Clad Steels," shows how protection against metallic contamination can be assured and corrosion prevented at savings in material cost up to 60% over the cost of solid corrosion-resistant metal. Your copy on request.

LUKENS STEEL COMPANY • 321 LUKENS BUILDING • COATESVILLE, PA.



Evaporator with tube sheets and down take fabricated of Lukens Nickel-Clad Steel. The customer states "Nickel-Clad Steel sheets are easier to install than ingot iron, since field welding can be done without decreasing its resistance to corrosion embrittlement." The unit was fabricated by Goslin Birmingham Mfg. Co., Birmingham, Ala., for Southern Alkali Corporation, Corpus Christi, Texas.



Tube sheets and pipes of this caustic solution cooler were fabricated by The Sims Company, Erie, Pa., of Lukens Nickel-Clad Steel, 9/16" thick. A strong caustic solution is handled in this equipment, installed at Goodyear Tire and Rubber Company, Akron, Ohio.

Dibutyl Phthalate

January 1, 1944–June 30, 1945

	1,000 Lb.	Percent
Total allocations	78,108	100.0
Direct military	58,247	74.6
Foreign	2,879	3.7
Other uses	16,982	21.7
Synthetic rubber	4,698	6.0
Insect repellants	3,712	4.8
Plastics	2,877	3.7
Lacquers	1,956	2.5
Cellophane	1,507	1.9
Adhesives	933	1.2
Photography	579	0.7
Textile coatings	245	0.3
Cable	225	0.3
Miscellaneous	250	0.3

Phthalate Plasticizers

Except Diethyl, Dimethyl, and Dibutyl
January 1, 1944–December 31, 1944

	1,000 Lb.	Percent
Total allocations	20,029	100.0
Export	224	1.1
Other uses	19,805	98.9
Cable-lacquer and penetrants	11,165	55.7
Textile coatings	4,231	21.1
Cellophane	1,645	8.2
Emulsions	770	3.9
Synthetic rubber	637	3.2
Plastics	574	2.9
Lacquer	353	1.8
Adhesives	268	1.3
Film	146	0.7
Miscellaneous*	16	0.1

* Includes material offered for resale.

Cresols and Cresylic Acid

January 1, 1944–December 31, 1944

	1,000 Lb.	Percent
Total allocations	83,345	100.0
Foreign	212	0.3
Chemical uses	52,198	62.6
Phenolic resins	28,674	34.4
Tricresyl phosphate	23,065	27.6
Other chemicals	459	0.6
Other uses	30,935	37.1
Ore flotation	7,888	9.4
Carbon remover	7,446	9.0
Disinfectants	7,613	7.9
Oil refining*	2,819	3.4
Textiles	1,983	2.4
Medicinals	284	0.3
Dyes and inks	231	0.3
Miscellaneous	3,671	4.4

* Includes oil additives.

Ethylene Glycol

January 1, 1944–December 31, 1944

	1,000 Lb.	Percent
Total allocations	189,169	100.0
Export[1]	32,850	17.4
Other causes	156,319	82.6
Anti-freeze[2]	119,874	63.4
Explosives	14,843	7.8
Cellophane	6,650	3.5
Coolants	6,192	3.3
Chemicals and synthetic resins	3,826	2.0
Hydraulic brake fluid[3]	3,202	1.7
Radio condenser fluid	538	0.3
Textiles and rayon	140	0.1
Miscellaneous[4]	1,054	0.5

[1] Excludes Canada; see note 2. [2] Includes military requirements plus a small amount for undesignated purposes and all civilian and Canadian anti-freeze assignments. [3] Includes de-icing preparations. [4] Includes ethylene glycol used for drugs and cosmetics; for wood stains, molding-sand binders, cutting oils, and gas and air dehydration.

Phosphorus

January 1, 1944–December 31, 1944

	1,000 Lb.	Percent
Total allocations	177,787	100.0
Direct military	64,190	36.0
Foreign	5,507	3.0
Other uses	108,090	61.0
Foods and fertilizers	38,166	21.5
Plastics, coatings, and surface protection	26,253	14.8
Soaps and detergents	19,669	11.1
Petroleum refining	6,681	3.8
Matches and fire retardants	5,304	3.0
Pharmaceuticals and dentifrices	4,047	2.3
Miscellaneous	7,968	4.5

Kidde announces

still another Fire-fighting Advance!

We've packed in an extra pound of carbon dioxide, compared with the Model 4

—We've knocked 2 1/2 pounds off the average charged weight!

The NEW Model 5 Extinguisher

And . . . this harder-hitting, lighter-weight extinguisher *costs no more* than the Model 4 it replaces!

The new Kidde Model 5 *adds* the advantage of increased flame-killing power . . . *retains* the features that led to the widespread popularity of the Model 4. Such features as:

Simple trigger control . . . just aim at the fire, pull the trigger. Fast attack on incipient fires in flammable liquids or electrical equipment. *Complete* freedom from extinguishing-agent damage . . . the dry, clean carbon dioxide cannot corrode metals, harm materials, contaminate liquids. No after-fire mess to clean up.

Get the full facts on the Kidde Model 5 . . . *today!*

Walter Kidde & Company, Inc., 928 Main Street, Belleville 9, New Jersey

The word "Kidde" and the Kidde seal are trade-marks of Walter Kidde & Company, Inc.

Kidde

United States Production of Certain Chemicals

June 1946, June 1945 and Six-Month Totals for 1946 and 1945

Chemical and Basis	Units	June 1946	June 1945	Total, 6 Months 1946	1945
Ammonia, synthetic anhydrous	Tons	60,609	45,072	263,871	282,705
Ammonium nitrate (100% NH_4NO_3)	Tons	62,445	.....	259,820	.....
Ammonium sulphate, synthetic	M lb.	13,238	.....	102,608	.....
Calcium arsenate (100% $Ca_3(AsO_4)_2$)	M lb.	4,116	5,157	14,130	15,222
Calcium carbide (commercial)	Tons	43,124	63,134	249,867	373,790
Calcium phosphate:					
Monobasic (100% $CaH_4(PO_4)_2$)	M lb.	5,233	4,806	33,769	30,798
Dibasic (100% $CaHPO_4$)	M lb.	5,670	2,533	39,742	20,911
Carbon dioxide:					
Liquid and gas	M lb.	16,774	18,572	101,922	106,447
Solid (dry ice)	M lb.	61,771	65,789	302,717	329,552
Chlorine	Tons	96,420	106,699	552,319	623,994
Chrome yellow and orange (C.P.)	M lb.	2,931	3,223	23,932	20,094
Chrome green (C.P.)	M lb.	1,320	351	10,093	2,894
Hydrochloric acid (100% HCl)	Tons	27,438	37,348	161,100	218,562
Hydrogen	M cu. ft.	1,374,000	2,155,000	8,267,000	12,532,000
Lead arsenate (acid and basic)	M lb.	5,091	5,485	44,309	47,518
Molybdate chrome orange (C.P.)	M lb.	365	130	2,566	782
Nitric acid (100% HNO_3)	Tons	55,416	39,662	216,056	240,378
Oxygen	M cu. ft.	869,206	1,233,506	12,962,871	8,184,008
Phosphoric acid (50% H_3PO_4)	Tons	68,706	61,438	414,799	335,869
Soda ash (commercial sodium carbonate):					
Ammonia soda process (98-100% Na_2CO_3):					
Total wet and dry[2]	Tons	308,623	358,782	2,064,672	2,203,252
Finished light[3]	Tons	148,861	189,444	1,120,203	1,181,578
Finished dense	Tons	107,615	115,675	724,899	691,997
Natural[4]	Tons	17,267	15,980	100,174	91,477
Sodium bicarbonate (refined) (100% $NaHCO_3$)	Tons	13,355	13,954	102,499	85,490
Sodium bichromate and chromate	Tons	6,285	5,951	43,864	40,215
Sodium hydroxide (100% NaOH):					
Electrolytic process:					
Liquid[5]	Tons	93,694	101,461	534,165	590,754
Solid	Tons	14,043	19,128	93,768	112,889
Line soda process:					
Liquid[5]	Tons	55,047	58,974	362,780	375,650
Solid	Tons	14,043	21,382	115,440	122,410
Sodium phosphate:					
Monobasic (100% NaH_2PO_4)	Tons	667	1,244	5,570	7,396
Dibasic (100% Na_2HPO_4)	Tons	3,070	5,621	28,870	28,788
Tribasic (100% Na_3PO_4)	Tons	5,960	7,198	48,495	41,479
Meta (100% $NaPO_3$)	Tons	1,688	2,466	13,676	18,823
Tetra (100% $Na_4P_2O_7$)	Tons	6,871	3,631	40,463	18,823
Sodium silicate (anhydrous)	Tons	34,912	43,733	193,234	233,561
Sodium sulphate:					
Anhydrous, refined (100% Na_2SO_4)	Tons	8,645	5,715	[8]114,488	41,153
Glaubers salt	Tons	13,567	19,352	92,312	110,066
Crude salt cake	Tons	44,184	42,207	208,692	270,503
Sulphuric acid (100% H_2SO_4)[7]					
Chamber process	Tons	230,241	254,975	1,516,749	1,636,467
Net, contract process[6]	Tons	457,327	481,561	2,673,157	2,887,242

Data for this tabulation have been taken from "Facts for Industry" series issued by Bureau of the Census and WPB Chemicals Bureau. Production figures represent primary production and do not include purchased or transferred materials. Quantities produced by government-owned arsenals, ordnance works, and certain plants operated for the government by private industry are not included. Chemicals manufactured by TVA, however, are included. All tons are 2,000 lb. Where no figures are given, data are either confidential or not yet available. [1] Includes a small amount of aqua ammonia. [2] Total wet and dry production, including quantities diverted for manufacture of caustic soda and sodium bicarbonate, and quantities processed to finished light and finished dense. [3] Not including quantities converted to finished dense. [4] Data collected in cooperation with the Bureau of Mines. [5] Figures represent total production of liquid material, including quantities evaporated to solid caustic and reported as such. [6] Includes oleum grades, excludes spent acid. [7] Data for sulphuric acid manufactured as a byproduct of smelting operations are included. This production by eight smelters was formerly reported to the Bureau of Mines. [8] Revised.

United States Production of Certain Synthetic Organic Chemicals

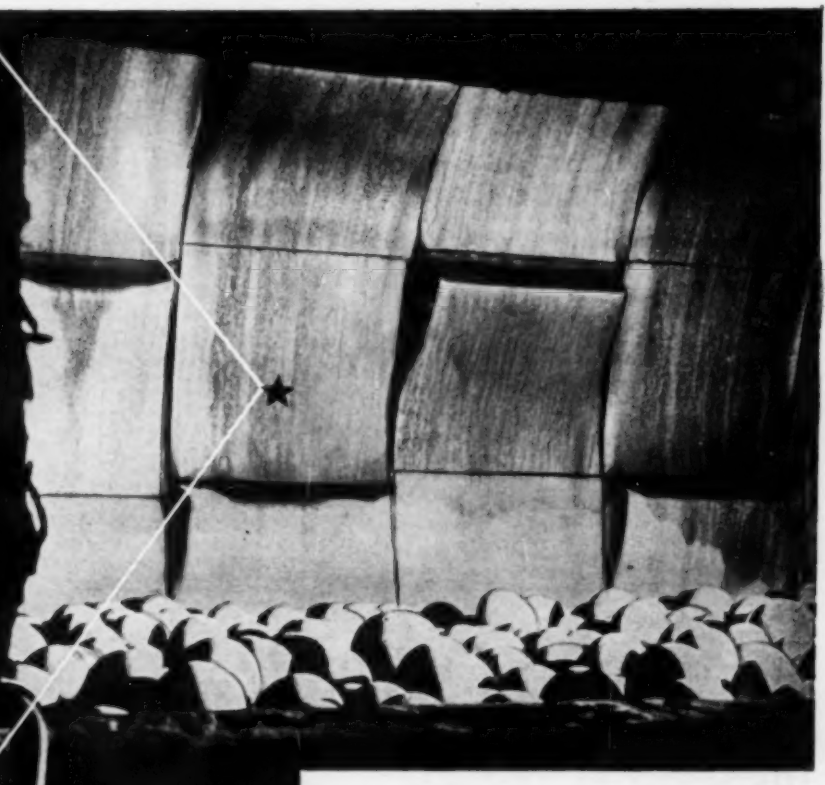
May 1946, May 1945 and Five-Month Totals for 1946 and 1945

Chemical	May 1946	May 1945	Total, 5 Months 1946	1945
Acetanilid, technical and U.S.P.	474,208	719,711	2,891,028	2,406,281
Acetic acid:				
Synthetic[1]	20,714,972	24,469,552	109,798,765	118,528,647
Recovered	95,293,469	.....	487,529,259	.....
Natural[2,3]	2,550,689	3,039,885	10,327,586	14,937,791
Acetic anhydride[4]	40,756,608	46,845,371	213,637,539	226,386,522
Acetone	26,046,575	.....	133,024,846	.....

(*Continued on page* 288)

These NI-HARD* NICKEL cast iron liners...

Outlasted plain chilled Cast iron 3 to 1



*Ni-Hard—Reg. U. S. Pat. Off. by The International Nickel Company, Inc., Canadian Pat. No. 281,986

Interior view of first compartment in mill for grinding wet stone at Keystone Portland Cement Co. showing alloyed liners. These wave-type liners, cast without bolt holes and keyed in place, measure 17" square by 3" thick. They were supplied in ABK Metal by American Brake Shoe Company, Mahwah, N. J., an experienced producer of this Ni-Hard type alloy.

Searching for ways to combat excessive wear, Keystone Portland Cement Company instituted a long time service test for ABK Metal, a Ni-Hard type alloy mill liner, comparing it with liners of plain chilled cast iron.

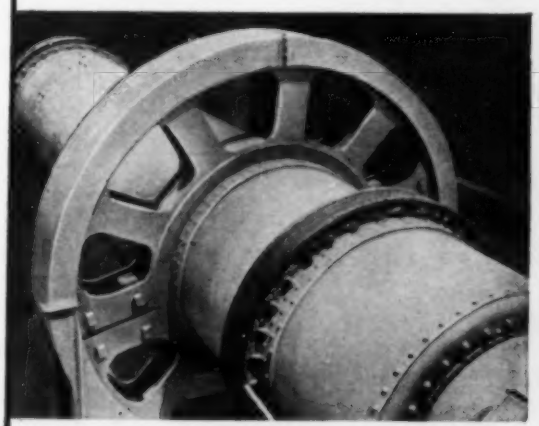
In a mill grinding raw wet stone . . . where abrasion is most severe . . . Ni-Hard demonstrated its exceptional merit by grinding the equivalent of 2,030,000 barrels of cement and remaining still in service for much more grinding. In identical service, plain chilled cast iron liners were good for only 751,000 barrels, a 2.7 to 1 performance with more to come.

This outstanding performance of Ni-Hard led Keystone to install these alloyed liners in their other raw grinding mills.

Ni-Hard is an alloy cast iron containing 4.25 to 4.75% Nickel together with 1.50 to 2.00% chromium. Its excellent resistance to wear and abrasion has led to its wide use in many types of crushing and grinding equipment.

The cement, paint, ceramic, power, mining, coal and coke, and many other industries have adopted Ni-Hard as standard for processing and conveying highly abrasive products. Applications include pump casings, roll heads, muller tires, chutes, ash pipe and grizzly discs.

You'll find it pays to specify Ni-Hard. For additional information write to:



Exterior view of Polysius compartment mill, one of eight used at the Keystone Portland Cement Company plant in Bath, Pa.

THE INTERNATIONAL NICKEL COMPANY, INC. 67 Wall Street New York 5, N.Y.

U.S. Production of Synthetic Organic Chemicals (Cont. from page 286)

Chemical	May 1946	May 1945	Total, 5 Months 1946	Total, 5 Months 1945
Aniline	6,721,261	.....	34,428,842	.....
Acetylsalicylic acid	975,168	924,877	4,885,328	4,499,772
Barbituric acid derivatives:[3]				
5-Ethyl-5-phenylbarbituric acid and salts (Phenobarbital)	41,313	35,572	166,269	124,386
Benzene:				
Motor grade:				
Tar distillers[4]	782,756	.....	4,668,216	.....
Coke-oven operators[5]	1,831,124	.....	11,252,836	.....
All other grades:				
Tar distillers[4]	2,451,310	.....	10,040,066	.....
Coke-oven operators[5]	5,019,921	.....	35,169,996	.....
Butyl alcohol, primary, normal	8,586,333	.....	41,677,893	.....
Carbon bisulphide	22,941,851	.....	[11]120,569,035	.....
Carbon tetrachloride	8,816,061	.....	57,278,963	.....
Chlorobenzene, mono	24,713,262	.....	111,401,797	.....
Creosote oil:				
Tar distillers	8,527,236	12,899,638	46,608,192	56,612,024
Coke-oven operators	964,830	3,173,432	8,790,703	15,845,719
Cresols:[7]				
Meta-para	204,589	1,036,179	1,931,860	3,599,710
Ortho-meta-para	.....	808,082	.....	3,222,604
Cresylic acid, refined[7]	1,681,605	2,273,115	9,470,273	12,987,909
Dibutyl phthalate	1,091,150	.....	.....	.....
Dichlorodiphenyltrichloroethane (DDT)	4,079,607	.....	18,311,281	.....
Ethyl acetate (85 percent)	7,179,862	9,929,117	35,373,038	47,139,363
Ethyl ethers, technical and U.S.P.	3,909,827	9,199,426	14,020,111	40,308,861
Formaldehyde (37 percent by wt.)	34,162,455	.....	193,706,379	.....
Methanol:				
Natural	1,378,637	[r]1,819,360	6,552,159	[r]8,207,040
Synthetic	7,431,682	44,587,600	187,395,705	213,582,240
Naphthalene:				
Tar distillers (Less than 79° C.)[4]	15,280,487	17,570,935	74,109,081	84,312,190
Tar distillers (79° C. and over)[4]	7,889,395	6,212,199	41,354,610	28,852,165
Coke-oven operators (Less than 79° C.)[5]	2,152,410	7,579,986	21,045,883	37,759,521
Penicillin[8]	2,678,000	.....	10,320,720	.....
Phenol, (synthetic and natural)	17,219,914	.....	82,502,501	.....
Phthalic anhydride	8,127,695	12,330,106	43,376,957	55,213,008
Styrene (government owned plants only)	33,557,386	.....	149,134,634	.....
Toluene:				
Coke-oven operators[5]	1,280,479	.....	6,738,647	.....
All other[5,10]	959,057	.....	5,148,138	.....

All data in pounds except benzene (gal.), creosote oil (gal.), toluene (gal.), and penicillin (million Oxford units). Statistics collected and compiled by U. S. Tariff Commission except where noted. Absence of data on production indicates either that returns were unavailable or confidential. [1] Excludes the statistics on recovered acid. [2] Acid produced by direct process from wood and from calcium acetate. [3] All acetic anhydride including that from acetic acid by vapor-phase process. [4] Product of distillers who use purchased coal tar only. [5] Statistics are given in terms of bulk medicinals only. [6] Statistics collected by Bureau of Mines. [7] Total production including data reported both by coke-oven operators and by distillers of purchased coal tar. [8] Reported to U. S. Bureau of the Census. [9] Reported in gal. by Bureau of the Census but converted to lb. for comparison with the production of synthetic methanol. [10] Includes toluene produced from petroleum by any process. [11] Revised.

FEATURED CHEMICALS in the PFIZER FAMILY

- Acetyl Tributyl Citrate
- Acetyl Triethyl Citrate
- Ammonium Oxalate
- Ascorbic Acid
- Bi-Cap Flour Enrichment Mixtures
- Bismuth Preparations
- Calcium Gluconate
- Citric Acid
- ✔ Citrate Esters
- Cream Tartar
- Fumaric Acid
- Gluconic Acid
- Glucono Delta Lactone
- Iron and Ammonium Citrates
- Iron and Ammonium Oxalate
- Iron Gluconate
- Iron Oxalate
- Itaconic Acid
- Niacin
- Niacinamide
- Oxalates
- Penicillin
- Potassium Iodide
- Potassium Oxalate
- Riboflavin
- Rochelle Salt
- Sodium Citrate
- Sodium Gluconate
- Tartaric Acid
- Thiamine
- Triethyl Citrate

—and many other chemicals

no. 4 in a series:

CITRATE ESTERS

In the production of lacquers and film forming materials, Pfizer Citrate Esters offer a wide choice of solvent plasticizers.

If you want to impart oil resistance to films, for example, Pfizer *Triethyl Citrate* may be the ester you need. If you want to inhibit discoloration of products by light, it may pay you to investigate Pfizer *Tributyl Citrate*. As a plasticizer for cellulose acetate, Pfizer offers its *Acetyl Triethyl Citrate*, while its *Acetyl Tributyl Citrate* has given good results as a solvent plasticizer for nitrocellulose, ethyl cellulose and other cellulose esters and ethers.

Write for further information on these esters. Each has specific characteristics which specially suit it for certain specific uses. Yet each has one thing in common with the more than a hundred products bearing the Pfizer name: Each reflects its maker's background — a business founded and maintained for nearly a century by chemically-minded men who have consistently kept out in front with the latest proved developments of modern science. Chas. Pfizer & Co., Inc., 81 Maiden Lane, New York 7, N. Y.; 444 West Grand Avenue, Chicago 10, Ill.; 605 Third St., San Francisco 7, Cal.

PFIZER

Manufacturing Chemists Since 1849

CHEMICAL ENGINEERING Weighted Index of Prices for CHEMICALS

Base = 100 for 1937

This month	**111.36**
Last month	111.36
September, 1945	108.63
September, 1944	109.37

CURRENT PRICES

The accompanying prices refer to round lots. Where it is trade custom to sell f.o.b. works, quotations are so designated. Prices are corrected to September 11.

INDUSTRIAL CHEMICALS

Acetone, tanks, lb	$0.06 –
Acid, acetic, 29% bbl., 100 lb	3.38 – $3.63
Boric, bbl., ton	109.00 –113.00
Citric, drums, lb	.22½– .23
Formic, cbys, lb	.10½– .11
Hydrofluoric, 30%, drums, lb	.08 – .085
Lactic, 44% tech., light, bbl., lb	.073– .075
Muriatic, 18°, tanks, 100 lb	1.05 –
Nitric, 36°, carboys, lb	.05 – .02½
Oleum, tanks, wks, ton	18.50 – 20.00
Oxalic crystals, bbl., lb	.11½– .12½
Phosphoric tech., tanks, lb	.04 –
Sulphuric, 60°, tanks, ton	13.00 –
Tartaric, powd., bbl., lb	.62 – .65
Alcohol, amyl from pentane, tanks, lb	.131 –
Alcohol, butyl, tanks, lb	.10½– .243
Alcohol ethyl, denatured, No. 1 special, tanks, gal	.542 –
Alum, ammonia, lump, lb	.04½–
Aluminum sulphate, com. bags, 100 lb	1.15 – 1.45
Ammonia, anhydrous, cyl., lb	.14½–
tanks, ton	59.00 – 61.50
Ammonium carbonate, powd., casks, lb	.09½– .10
Sulphate, wks., ton	30.00 –
Amyl acetate, tech. from pentane, tanks, lb	.15½–
Aqua ammonia, 26°, drums, lb	.02½– .03
tanks, ton	65.00 –
Arsenic, white, powd., bbl., lb	.05 – .05½
Barium carbonate, bbl., ton	65.00 – 75.00
Chloride, bbl., ton	75.00 – 78.00
Nitrate, casks, lb	.09½ .11
Blanc fixe, dry, bags, ton	60.00 – 70.00
Bleaching powder, f.o.b., wks., drums, 100 lb	2.50 – 3.00
Borax, gran., bags, 100 lb	45.00 –
Calcium acetate, bags, 100 lb	3.00 –
Arsenate, dr., lb	.07½– .08
Carbide, drums, ton	50.00 –
Chloride, flake, bags, del., ton	18.50 – 25.00
Carbon bisulphide, drums, lb	.05 – .05
Tetrachloride, drums, gal	.73 – .80
Chlorine liquid, tanks, wks., 100 lb	1.75 – 2.00
Copperas, bgs., f.o.b., wks., ton	17.00 – 18.00
Copper carbonate, bbl., lb	.19½– .20
Sulphate, bbl., 100 lb	5.65 – 6.15
Cream of tartar, bbl., lb	.50 – .52
Diethylene glycol, dr. lb	.14½– .15½
Epsom salt, dom., tech., bbl., 100 lb.	1.80 – 2.00
Ethyl acetate, tanks, lb	.08½– .11½
Formaldehyde, 30%, tanks, lb. wks.	.032–
Furfural, tanks, lb	.09½–
Glaubers salt, bags, 100 lb	1.05 – 1.10
Glycerine c.p. drums, extra, lb	.18½– .19
Lead:	
White, basic carbonate, dry, casks, lb	.10 –
Red, dry, sck., lb	.10½–
Lead acetate, white crys., bbl., lb	.12½– .13
Arsenate, powd., bags, lb	.13½– .14½
Lithopone, bags, lb	.044 – .049
Magnesium carb., tech., bags, lb	.07½– .08
Methanol, 95%, tanks, gal	.60 –
Synthetic, tanks, gal	.24 –
Phosphorus, yellow, cases, lb	.23 – .25
Potassium bichromate, bags, lb	.10 – .10½
Chlorate, powd., lb	.09½– .12
Hydroxide (c'stic potash) dr., lb	.07 – .07½
Muriate, 60%, bags, unit	.53½–
Nitrate, ref., bbl., lb	.08 – .09
Permanganate, drums, lb	.19½– .20
Prussiate, yellow, casks, lb	.16 – .17
Sal ammoniac, white, casks, lb	.0515– .06
Salsoda, bbl., 100 lb	1.00 – 1.05
Salt cake, bulk, ton	15.00 –
Soda ash, light, 58%, bags, contract, 100 lb	1.05 –
Dense, bags, 100 lb	1.15 –
Soda, caustic, 76% solid, drums, 100 lb	2.30 – 3.00
Acetate, del., bbl., lb	.05½– .06
Bicarbonate, bbl., 100 lb	1.70 – 2.00
Bichromate, bags, lb	.07½– .08
Bisulphate, bulk, ton	16.00 – 17.00
Bisulphite, bbl., lb	.03 – .04

CHEMICAL ENGINEERING
Weighted Index of Prices for
OILS & FATS

Base = 100 for 1937

This month	**152.23**
Last month	166.39
September, 1945	145.63
September, 1944	145.04

Chlorate, kegs, lb	$0.06½	– $0.06¾
Cyanide, cases, dom., lb	.14½	– .15
Fluoride, bbl., lb	.07	– .08
Hyposulphite, bags, 100 lb	2.25	– 2.50
Metasilicate, bbl., 100 lb	2.50	– 2.65
Nitrate, bulk, ton	27.00	–
Nitrite, casks, lb	.06½	– .07
Phosphate, tribasic, bags, 100 lb	2.70	–
Prussiate, yel., bags, lb	.10½	– .11
Silicate, 40°, dr., wks., 100 lb	.80	– .85
Sulphite, crys., bbl., lb	.02½	– .02¾
Sulphur, crude at mine, long ton	16.00	–
Dioxide, cyl., lb	.07	– .08
Dioxide, tanks, lb	.04	–
Tin crystals, bbl., lb	.39½	–
Zinc chloride, grain, bbl., lb	.05½	– .06
Oxide, lead free, bags, lb	.08½	–
Oxide, 5% leaded, bags, lb	.08½	–
Sulphate, bbl., cwt	3.85	– 4.00
OILS AND FATS		
Castor oil, No. 3 bbl., lb	$0.14½	– $0.15½
Chinawood, oil, tanks, lb	.30	–
Coconut oil, Ceylon, N. Y., lb	.0885	–
Corn oil crude, tanks (f.o.b. mill), lb	.12½	–
Cottonseed oil crude (f.o.b. mill), tanks, lb	.12½	–
Linseed oil raw, car lots, dr., lb	.168	–
Palm, casks, lb	.0865	–
Peanut oil, crude, tanks (mill), lb	.12½	–
Rapeseed oil, refined, bbl., lb	nom.	
Soybean, tanks, lb	.11½	–
Menhaden, light, pressed, dr., lb	.13	–
Crude, tanks (f.o.b. factory), lb	.089	–
Grease, yellow, loose, lb	.08½	–
Oleo stearine, lb	.09½	–
Oleo oil, No. 1, lb	.13	–
Red oil, distilled, bbl., lb	.13½	–
Tallow extra, loose, lb	.08½	–
COAL-TAR PRODUCTS		
Alpha-naphthol, crude, bbl., lb	$0.52	– $0.55
Alpha-naphthylamine, bbl., lb	.32	– .34
Aniline oil, drums, lb	.11½	– .12½
Aniline salts, bbl., lb	.22	– .24
Benzaldehyde, tech., dr., lb	.45	– .50
Benzidine base, bbl., lb	.70	– .75
Benzoic acid, USP, kegs, lb	.54	– .56
Benzol, 90%, tanks, works, gal	.15	–
Benzyl chloride, tech., dr., lb	.22	– .24
Beta-naphthol, tech., drums, lb	.21	– .22
Cresol, USP, dr., lb	.11½	–
Cresylic acid, dr., wks., gal	.81	– .83
Diphenyl, bbl., lb	.15	–
Diethylaniline, dr., lb	.40	– .45
Dinitrotoluol, bbl., lb	.18	– .19
Dinitrophenyl, bbl., lb	.22	– .23
Dip oil, 15%, dr., gal	.23	– .25
Diphenylamine, dr., f.o.b. wks., lb	.25	–
H acid, bbl., lb	.45	– .50
Hydroquinone, bbl., lb	.90	–
Naphthalene, flake, bbl., lb	.09½	– .10
Nitrobenzene, dr., lb	.08	– .09
Para-cresol, bbl., lb	.41	–
Para-nitroaniline, bbl., lb	.42	– .43
Phenol, USP, drums, lb	.10	– .11
Picric acid, bbl., lb	.35	– .40
Pyridine, dr., gal	1.55	– 1.60
Resorcinol, tech., kegs, lb	.65	– .70
Salicylic acid, tech., bbl., lb	.26	– .33
Solvent naphtha, w.w., ranks, gal	.26	–
Toluidin, bbl., lb	.96	–
Toluol, drums, works, gal	.27	–
Xylol, com., tanks, gal	.22	–
MISCELLANEOUS		
Casein, tech., bbl., lb	$0.33	– $0.35
Dry colors:		
Carbon gas, black (wks.), lb	.0365	– .097
Prussian blue, bbl., lb	.36	– .37
Ultramarine blue, bbl., lb	.11	– .26
Chrome, green, bbl., lb	.24	– .33
Carmine, red, tins, lb	5.50	– 6.00
Para toner, lb	.75	– .80
Vermilion, English, bbl., lb	2.50	– 2.60
Chrome yellow, C.P., bbl., lb	.17	– .18
Gum copal, Congo, bags, lb	.09	– .55
Manila, bags, lb	.09	– .15
Damar, Batavia, cases, lb	.10	– .22
Kauri, cases, lb	.18	– .60
Magnesite, calc., ton	64.00	–
Pumice stone, lump, bbl., lb	.05	– .07
Rosin, H., 100 lb	8.15	–
Shellac, orange, fine, bags, lb	.70	–
Bleached, bonedry, bags, lb	.69	–
T. N., bags, lb	.71	–
Turpentine, gal	1.06	–

NEW CONSTRUCTION

	Current Projects		Cumulative 1946	
	Proposed Work	Contracts	Proposed Work	Contracts
New England	.....	$60,000	$715,000	$6,144,000
Middle Atlantic	.....	2,160,000	9,096,000	31,326,000
South	$5,375,000	5,000,000	60,942,000	70,240,000
Middle West	2,023,000	2,355,000	14,546,000	44,805,000
West of Mississippi	3,320,000	475,000	89,136,000	79,443,000
Far West	.....	3,185,000	7,855,000	29,838,000
Canada	.....	130,000	405,000	15,793,000
Total	$10,718,000	$13,365,000	$182,695,000	$277,589,000

PROPOSED WORK

Ala., Mobile—Tennessee Valley Authority, Knoxville, Tenn., plans to construct a phosphate fertilizer plant here. Estimated cost $3,000,000.

Ill., Crystal Lake—The Pure Oil Co., Pure Oil Bldg., Chicago, plans to construct a research and development laboratory on a 68 acre site here. Estimated cost will exceed $400,000.

Ill., Joliet—Blackson Chemical Co., Joliet, plans to construct a 2 and 3 story chemical laboratory and administration building. Dubin & Dubin, 127 North Dearborn St., Chicago, Archts.

Miss., Laurel—Jones County Cooperative, c/o Charles McNeil, Mgr., plans to construct a superphosphate manufacturing plant; also a fertilizer plant. Estimated cost $150,000 and $100,000 respectively.

O., Toledo—Libbey Glass Div., Owens-Illinois Glass Co., Ash St., plans alterations and additions to its factory and warehouse here. Estimated cost $843,000.

O., Wapokoneta—G. A. Wintzer & Sons Co., Wapokoneta, plans to construct a plant for rendering tallow for soaps and processing meat scraps for stock feeding. Estimated cost $150,000.

Okla., Duncan—W. P. Halliburton, Inc., Duncan, plans to construct a portland cement plant. Estimated cost $300,000.

S. C., Charleston—Naco Fertilizer Co., Charleston, plans to construct a superphosphate manufacturing plant. Estimated cost $120,000.

S. C., Laurens—Laurens Glass Works, Laurens, plans to construct an addition to its glass plant. Estimated cost $750,000.

S. C., North Charleston—Charleston Development Corp., Charleston, plans to construct a chemical plant here to be leased to Amitas, Ltd., 50 Bway., New York City. Estimated cost $1,200,000.

Tenn., Memphis—Southern Cotton Oil Co., Memphis, plans to construct a shortening plant. Norton & Rice, 165 Baptist Hospital Bldg., Memphis, Archts.

Tex., Alvin—Phillips Petroleum Co., Neils Esperson Bldg., Houston, plans to construct a gas distillate plant. Estimated cost $2,000,000.

Tex., Beaumont—Earle P. Halliburton, Inc., Duncan, Okla., plans to construct a portland cement manufacturing plant here. Estimated cost $500,000.

Tex., Harlingen—Regional Cooperative Assn., Harlingen, plans to construct a cottonseed sterilizer and cotton oil mill. Estimated cost $200,000.

Tex., Houston—Clorax Chemical Co., Oakland, Calif., plans to construct a chemical plant warehouse. Estimated cost $220,000.

Tex., Houston—Independent Oxygen Co., 2707 Fenwood St., plans to construct an oxygen and acetylene producing plant. Estimated cost $100,000.

Wis., Sheboygan—Wisconsin Oil Refining Co., Sheboygan, plans to construct an additional refinery unit. Estimated cost $575,000.

CONTRACTS AWARDED

Calif., Antioch—Glass Containers, Inc., subsidiary of Fibreboard Products, Inc., Russ Bldg., San Francisco, has awarded the contract for a glass manufacturing plant to Swinerton & Walberg Co., 225 Bush St., San Francisco. Estimated cost will exceed $55,000.

Calif., Avon—Tidewater Associated Oil Co., Avon, has awarded the contract for a crude distillation unit, control building, stills, towers, tanks, etc., to Bechtel-Bros.-McCone Co., 220 Bush St., San Francisco. Estimated cost $2,500,000.

Calif., Bell Gardens—California Enameling Co., 6650 East Slauson Ave., has awarded the contract for an addition to its plant to H. F. Hendrickson Co., 2811 Clearwater St., Los Angeles. Estimated cost $125,000.

Calif., Pittsburg—The Dow Chemical Co., Pittsburg, has awarded the contract for the construction of an iodine production plant on Centinella Ave. near Maplewood Blvd., to The Austin Co., 777 East Washington Blvd., Los Angeles. Estimated cost $150,000.

Ill., Chicago—Republic Plating & Processing Co., 4450 West 5th Ave., has awarded the contract for an addition to its plant to J. Troshinsky, 179 West Washington St. Estimated cost $70,000.

Ill., Lincoln—Lehn & Fink Products Corp., 683 5th Ave., New York, N. Y., has awarded the contract for the construction of a factory and office building to B-W Construction Co., 307 North Michigan Ave., Chicago. Estimated cost $1,800,000.

Ill., Skokie—Public Service Co. of Northern Illinois, 72 West Adams St., Chicago, has awarded the contract for an addition to its gas plant to W. E. Schweitzer Co., 2207 Dodge Ave., Evanston. Estimated cost $185,000.

Md., Cedarhurst—Congoleum-Nairn Co., 295 5th Ave., New York, N. Y., has awarded the contract for an addition to its felt mill to Gahagan Construction Co., 90 Broad St., New York, and Byrne Organization, 2607 Connecticut Ave., N. W., Washington, D. C. Estimated cost $1,000,000.

Mass., Springfield—Monsanto Chemical Co., 812 Monsanto Ave., has awarded the contract for a boiler plant to Adams & Ruxton Construction Co., 1387 Main St. Estimated cost $60,000.

N. J., Camden—DiMedio Lime Co., 26 North 18th St., has awarded the contract for a 1 story manufacturing plant to Tomas Pagan, 933 North 30th St. Estimated cost $60,000.

N. J., New Brunswick—Zonite Products Corp., 370 Lexington Ave., New York, N. Y., has awarded the contract for an addition to its plant to Walter Kidde Constructors, Inc., 140 Cedar St., New York, N. Y. Estimated cost $300,000.

N. J., Paulsboro—Socony-Vacuum Oil Co., Paulsboro, has awarded the contract for a 2 story chemical research laboratory to Turner Construction Co., 1500 Walnut St., Philadelphia. Estimated cost $800,000.

O., Youngstown—Great Lakes Carbon Corp., Chicago, Ill., has awarded the contract for a plant for the manufacture of rock wool insulation to Joseph Bucheit & Sons Co., Youngstown. Estimated cost $200,000.

Ore., Oswego—Oregon Portland Cement Co., 111 S. E. Madison St., Portland, will construct a cement plant. Work will be done by day labor. Estimated cost $290,000.

Tex., Denver City—Frontier Chemical Co., c/o R. L. Wood, Pres., Midland, Tex., will construct an electrochemical manufacturing plant. Work will be done by owners. Estimated cost $475,000.

Wash., Seattle—Preservative Paint Co. and Wood Beautifiers, Inc., 703 Lucille St., has awarded the contract for a 2 story shingle staining plant and warehouse to H. E. Carlbom Construction Co., 6718 22nd Ave., N. W. Estimated cost $65,000.

W. Va., Follansbee—Wheeling Steel Corp., Wheeling, has awarded the contract for two 53 battery coke ovens to Koppers Co., Koppers Bldg., Pittsburgh, Pa.; brick stack to Rust Engineering Co., Rust Bldg., Pittsburgh, Pa. Estimated cost $5,000,000.

Wis., Green Bay—Phillips Petroleum Co., Chicago, Ill., has awarded the contract for the construction of a bulk oil plant to Chicago Bridge & Iron Co., Chicago. Estimated cost $100,000.

Ont., Brockville—Brockville Gas Co., Brockville, has awarded the contract for the construction of a gas plant to Brantford Engineering & Manufacturing Co., Ltd., 280 Ottawa St., N., Hamilton.

Ont., New Toronto—Dominion Colour Corp., New Toronto, has awarded the contract for the construction of a factory and office building to Mallenhauer Contracting Co., Ltd., 188 Perth Ave., Toronto. Estimated cost $75,000.